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Environmental Characterization of Geokinetics' In-situ Oil Shale Retorting Technology Field and Analytical Data Appendices

Monsanto Research Corp.
Dayton, OH

Prepared for

Industrial Environmental Research Lab.
Cincinnati, OH

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16. ABSTRACT

Air emissions and water effluents from true *in-situ* oil shale retorting were physically, chemically and biologically characterized by sampling of Geokinetics Retort No. 17, a pilot-scale unit which produced 30 barrels of crude shale oil per day during testing from July 16 to July 26, 1979. The potential pollution sources tested were the retor off-gases before and after mist elimination, exhaust from thermal incineration of the demister outlet gases, fugitive gas seepage throug the retort surface and around well casings, retort water after oil separation, and evaporation pond water. The three stack gas streams were analyzed for ammonia, arsine, carbon monoxide, hydrocarbons, hydrogen cyanide, oxides of nitrogen and sulfur, particulate matter, and trace elements. Hydrocarbons and carbon monoxide were quantified in the fugitive emission samples. Water quality parameters, organic priority pollutants, and trace elements were measured in the two water samples. Selected air and water pollution samples were tested for biological activity, using the Ames mutagenicity assay, the Chinese hamster ovary (CHO) clonal toxicity assay, and the rabbit alveolar macrophage (RAM) cytotoxicity assay.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Oil shale	Sampling	Geokinetics	
Retorts	Chemical analysis	Utah	
Air pollution	Bioassay	Fugitive emissions	
Water pollution			

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by

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PREFACE

The field and analytical data for Environmental Characterization of Geokinetics' *In-Situ* Oil Shale Retorting Technology are presented herein. Monsanto Research Corporation has made available for researchers at other laboratories the environmental source testing data collected during the field experiment at Geokinetics' Retort No. 17. Future environmental characterization of oil shale development will undoubtedly evolve into more sophisticated tiers of physical, chemical, and biological analyses as the shale industry nears commercialization. This effort is but a preliminary analysis on a research retort which should provide a baseline for future sampling and analysis activities.

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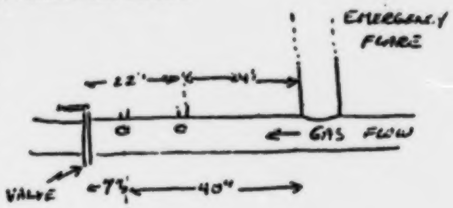
APPENDIX A

FIELD AND ANALYTICAL DATA FOR DETERMINATION OF PARTICULATE MATTER AND CARBON MONOXIDE

This appendix contains three principal groups of data sheets, for sampling of the demister inlet, the demister outlet, and the incinerator outlet, in that order. The data include: traverse point location, preliminary velocity traverse, moisture content, dry molecular weight, Method 5 readings, isokinetic calculation, and laboratory analyses.

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Geokinetics
DATE 7/18
SAMPLING LOCATION Inlet to Demister
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A)
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B)
STACK I.D., (DISTANCE A - DISTANCE B) 10"
NEAREST UPSTREAM DISTURBANCE 40" 4D
NEAREST DOWNSTREAM DISTURBANCE 7" 0.7D
CALCULATOR



SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.067	10"	3/4"	~~7~~ 11 1/4	~~7 3/4~~ 12
2	.25	10	2 1/2"	~~7~~ 11 1/4	~~9 1/2~~ 13 3/4
3	.75	10	7 1/2"	~~7~~ 11 1/4	~~14 1/2~~ 18 3/4
4	.933	10	9 1/4"	~~7~~ 11 1/4	~~16 1/4~~ 20 1/2

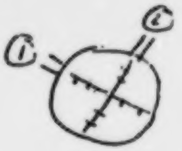
EPA (Dur) 232
4/72

CLASSIFICATION

ELITE
PICA

PRELIMINARY VELOCITY TRAVERSE

PLANT [illegible]
DATE 7/18/79
LOCATION Inlet to eliminator
STACK I.D. 10"
BAROMETRIC PRESSURE, in. Hg 23.65
STACK GAUGE PRESSURE, in. H_2O +5.00
OPERATORS WF + KC & DS



SCHEMATIC OF TRAVERSE POINT LAYOUT

	TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
Port 1	1	.230	128
	2	.390	131
	3	.440	133
	4.	.325	133
Port 2	1	.29	127
	2	.36	129
	3	.39	131
	4	.29	131
	AVERAGE	0.339	130.4

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
4/72

LAST LINE

CLASSIFICATION

In stack wet bulb-dry bulb moisture calculation:

Plant Geokinetics Location Inlet -

Stack Inlet to demister Run 2 Date 7/18/79

Operators DS + LC

Barometric Pressure (Hg) = BP = 23.68 in Hg

Static Pressure (in H_2O) P = 5.00 in H_2O

Absolute Pressure of Stack = $BP \pm \frac{P}{13.6}$ = P_s = 24.05 in Hg

Wet Bulb Temperature (°F) = T_w = 118 ~~110~~ °F

Dry Bulb Temperature (°F) = T_d = 130 °F

Temp Difference $(T_d - T_w)$ = ΔT = 12 °F

Vapor Pressure of H_2O at T_w (from table) VP = 3.259 ~~2.596~~ in Hg

Partial Pressure of H_2O = PP

$$PP = (\quad VP) - \frac{(P_s - VP)(\Delta T)}{2800 - (1.3)(T_w)}$$

$$PP = (\overset{3.259}{\cancel{2.596}}) - \frac{(24.05 - 3.259)(12)}{2800 - (1.3)(118)} = \overset{2.90}{\cancel{2.43}} \text{ in Hg}$$

% Moisture by volume = M

$$M = \frac{(PP)}{(P_s)}(100) = \frac{(2.90)}{(24.05)}(100) = \overset{12.07}{\cancel{10.10}} \ \%$$

Note plant data indicates 13% typical.

VAPOR PRESSURES OF WATER

°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg
0	.0376	33	.1878	53	.4052	73	.8183	93	1.561	113	2.829	133	4.900	153	8.150	173	13.07	193	20.27
2	.0417	34	.1955	54	.4203	74	.8462	94	1.610	114	2.911	134	5.031	154	8.351	174	13.37	194	20.70
4	.0463	35	.2035	55	.4359	75	.8750	95	1.660	115	2.995	135	5.165	155	8.557	175	13.67	195	21.14
6	.0517	36	.2118	56	.4520	76	.9046	96	1.712	116	3.081	136	5.302	156	8.767	176	13.98	196	21.59
8	.0571	37	.2203	57	.4686	77	.9352	97	1.765	117	3.169	137	5.442	157	8.981	177	14.30	197	22.05
10	.0631	38	.2292	58	.4858	78	.9666	98	1.819	118	3.259	138	5.585	158	9.200	178	14.62	198	22.52
12	.0696	39	.2383	59	.5035	79	.9989	99	1.875	119	3.351	139	5.732	159	9.424	179	14.96	199	22.99
14	.0768	40	.2478	60	.5218	80	1.032	100	1.932	120	3.446	140	5.881	160	9.652	180	15.29	200	23.47
16	.0846	41	.2576	61	.5407	81	1.066	101	1.992	121	3.543	141	6.034	161	9.885	181	15.63	201	23.96
18	.0932	42	.2677	62	.5601	82	1.102	102	2.052	122	3.642	142	6.190	162	10.12	182	15.98	202	24.46
20	.1025	43	.2782	63	.5802	83	1.138	103	2.114	123	3.744	143	6.350	163	10.36	183	16.34	203	24.97
22	.1127	44	.2891	64	.6009	84	1.175	104	2.178	124	3.848	144	6.513	164	10.61	184	16.70	204	25.48
24	.1248	45	.3004	65	.6222	85	1.213	105	2.243	125	3.954	145	6.680	165	10.86	185	17.07	205	26.00
26	.1370	46	.3120	66	.6442	86	1.253	106	2.310	126	4.063	146	6.850	166	11.12	186	17.44	206	26.53
27	.1429	47	.3240	67	.6669	87	1.293	107	2.379	127	4.174	147	7.024	167	11.38	187	17.82	207	27.07
28	.1502	48	.3364	68	.6903	88	1.335	108	2.449	128	4.289	148	7.202	168	11.65	188	18.21	208	27.62
29	.1567	49	.3493	69	.7144	89	1.378	109	2.521	129	4.406	149	7.384	169	11.92	189	18.61	209	28.18
30	.1647	50	.3626	70	.7392	90	1.422	110	2.596	130	4.525	150	7.569	170	12.20	190	19.01	210	28.75
31	.1716	51	.3764	71	.7648	91	1.467	111	2.672	131	4.647	151	7.759	171	12.48	191	19.42	211	29.33
32	.1803	52	.3906	72	.7912	92	1.513	112	2.749	132	4.772	152	7.952	172	12.77	192	19.84	212	29.92

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Ecolaitie

DATE 7/18/79

SAMPLING TIME (24-hr CLOCK) 16:20

SAMPLING LOCATION Inlet De-mister Run 1

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) Bag grab.

ANALYTICAL METHOD Orsat

AMBIENT TEMPERATURE 85 oF

OPERATOR L.M.C. Ph"D"

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	23.9	23.9	23.4	23.4			23.7	44/100	10.4
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	24.1	0.2	23.6	0.2			0.2	32/100	0.1
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	32.0	7.9	31.1	7.5			7.7	28/100	2.2
N_2 (NET IS 100 MINUS ACTUAL CO READING)		68.0		68.9			68.4	28/100	19.2
								TOTAL	31.9

31.1
.116
2.0

Note: Sample drawn into pipette appears cloudy. Cloudiness disappears after KOH passes!

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT GeoKinetics

DATE 7-19-79

SAMPLING TIME (24-hr CLOCK) 12:28 Am

SAMPLING LOCATION Inlet to Demister.

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) Bag

ANALYTICAL METHOD Orsat

AMBIENT TEMPERATURE (103°) Area) (78° Truck)

OPERATOR W. McDonald

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	23.0	23.0	23.0	23.0			23.0	44/100	10.1
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	24.2	1.2	24.2	1.2			1.2	32/100	0.4
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	30.4	6.2	water ~~24.4~~ 30.4 30.4	6.2			6.2	28/100	1.7
N_2 (NET IS 100 MINUS ACTUAL CO READING)							69.6	28/100	19.5
								TOTAL	31.7

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EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Geokinetics

DATE 7/19/79

SAMPLING TIME (24-hr CLOCK) 1510

SAMPLING LOCATION Inlet to Demister

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 106°F

OPERATOR W. N McDONALD

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	22.0	22.0	22.0	22.0			22.0	44/100	9.7
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	24.0	2.0	24.0	2.0			2.0	32/100	0.6
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	29.8 29.8	5.8	29.8	5.8			5.8	28/100	1.6
N_2 (NET IS 100 MINUS ACTUAL CO READING)							70.2	28/100	19.7
								TOTAL	31.6

EPA (Dur) 230
4/72

NOMOGRAPH DATA (HP-65)

PLANT Geokinetics USED ON RUN NO.:
DATE 7/19/79 CALCULATOR:
SAMPLING LOCATION Inlet to Demister

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS	
1	Run card			—	
2	Initialize program		A	0.00	
3	Enter average T_m (meter temp. °F + 460) If meter temp. unknown, use ambient + 20°F	560 °R	R/S	T_m	
4	Enter P_m (Barometric pressure at meter)	23.68 In. Hg	R/S	T_m/P_m	
5	Enter P_s (static pressure in stack) [P_m ± .073 x stack gauge pressure in In. H_2O]	24.05 In. Hg	R/S	P_s	
6	Enter average T_s (stack temperature + 460)	590.4 °R	R/S	P_s/T_s	
7	Enter B_{ms} (mole fraction of H_2O vapor in gas stream)	0.1207 ~~0.101~~ Fraction of H_2O	R/S	Fraction Dry	
8	Enter MD (molecular weight of dry gas)	31.9 lbs/lb mole	R/S	MW molecular wt of stack gas lbs/lb mole	
9	Enter C_p (type "S" pitot tube coefficient)	Est 0.78 —	R/S		
10	Enter average Δ_p Highest Δ_p (.440)	.339 In. H_2O	R/S	D_n theo. (nozzle dia. in inches)	.27
11	Initialize "B"	—	B	—	
12	Enter actual D_n	.240 In.	R/S	—	
13	Enter $\Delta H_@$ (Calibrated pressure differential across orifice)	1.785 In. H_2O	R/S	K factor 2.41	
14_1	Enter actual Δ_{p_1}	.339	E	ΔH_1 In. H_2O	.81.
14_2	Enter actual Δ_{p_2}	.440	E	ΔH In. H_2O	1.0
14_3	Enter actual Δ_{p_3}	.230	E	ΔH In. H_2O	.5

FIELD DATA

PLANT Geo Kinetics
DATE 7/19/79
SAMPLING LOCATION Inlet to Demister
SAMPLE TYPE EPA-5 for trace metal
RUN NUMBER 5-1
OPERATOR Sterling
AMBIENT TEMPERATURE ~~85~~ 90
BAROMETRIC PRESSURE 23.62
STATIC PRESSURE, (P_s) ±5.0C
FILTER NUMBER (s) 30

PROBE LENGTH AND TYPE 8'-S.S.
NOZZLE I.D. .240
ASSUMED MOISTURE, % 12.07
SAMPLE BOX NUMBER 1
METER BOX NUMBER 6
METER $\Delta H_@$ 1.785
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp K = 2.41 : ΔH:1

SCHEMATIC OF TRAVERSE POINT LAYOUT

before .003@ 20"

READ AND RECORD ALL DATA EVERY 5 MINUTES LEAK RATE .005 CFM @ 8 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	Probe
					DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
	0		428.696										
1	0	1359	428.696	.29	.70	.70	146	104	104	3.7	282	82	320
	5	1404	431.512	.29	.70	.70	146	107	104		285	80	314
	10	1409	434.248	.28	.67	.67	146	109	105	3.3	270	74	314
2	15	1414	436.944	.34	.82	.82	146	111	106	4.0	275	74	220
	20	1419	439.868	.34	.82	.82	149	112	107	4.2	270	73	217
	25	1424	442.825	.33	.80	.80	149	113	109	5.5	261	77	213
3	30	1429	445.830	.31	.75	.75	147	110	107	5.8	246	79	215
	35	1434	448.675	.31	.75	.75	148	110	108	5.8	249	80	213
	40	1439	451.528	.31	.75	.75	147	110	108	5.8	249	79	218
4	45	1444	454.410	.30	.72	.72	144	108	107	5.8	244	77	300
	50	1449	457.254	.30	.72	.72	144	108	107	6.0	245	78	255
	55	1454	460.095	.28	.67	.67	145	108	108		299	80	245.
1	60	1'	462.842										
			34.146			0.739	146.4	107.9					

CLEAN-UP DATA

Plant Geokinetics

Comments:

Date 7/18/79

Sampling Location INLET RUN 1

Sample Type Mod-Meth 5

Run Number

Sample Box Number #1

Clean-up Man Sterling ; Cash

IMPINGERS

	#1	#2	#3	#4	#5
Final Vol.	124 ml	237 ml	200 ml	ml	ml
Initial Vol.	100 ml	200 ml	200 ml	ml	ml
Net Vol.	24 ml	37 ml	0 ml	ml	ml

Total Net Volume in Impingers 61 ml

SILICA GEL

Final Weight	228.9 g	g	g
Initial Weight	202.0 g	g	g
Net Weight	26.9 g	g	g

Note Si Gel was black + oily in appearance

Total Net Weight in Silica Gel 26.9 g

Total Moisture 87.9 g

Filter Number(s) 202651-16

MRC 7/73

ISOKINETIC CALCULATION

Plant Geokinetics

Run# 1, Date 7/19/79

Location Inlet to Demister, Initials ARF

MOISTURE

Net volume of liquid collected in impingers and silica gel = V_L = 87.9 ml

Net volume of gas through dry gas meter at meter conditions = V_m = 34.146 cu.ft.

Barometric Pressure - absolute = BP = 23.62 in.Hg

Average absolute meter temperature (°F + 460) = T_m = 567.9 °R

Percent moisture = M

$$M = \frac{100}{1 + \dfrac{373.63\,(V_m)\,(BP)}{(T_m)\,(V_L)}}$$

$$= \frac{100}{1 + \dfrac{373.63\,(34.146)\,(23.62)}{(567.9)\,(87.9)}} = 14.2\ \%$$

MOLECULAR WEIGHT

Percent O_2 by volume dry basis = O_2 = ______ %

" CO " " " " = CO = ______ %

" CO_2 " " " " = CO_2 = ______ %

$N_2 = 100 - (O_2 + CO_2 + CO) = 100 - (\quad + \quad + \quad)$

Percent N_2 by volume dry basis = N_2 = ______ %

Dry molecular weight = MD

$MD = 0.44\,(CO_2) + 0.32\,(O_2) + 0.28\,(N_2 + CO)$

$MD = 0.44\,(\quad) + 0.32\,(\quad) + 0.28\,(\quad + \quad)$

MD = ~~2895~~ 31.73

ISOKINETIC CALCULATION (Cont.d)

MOLECULAR WEIGHT (Cont.d)

Stack gas molecular weight = MS

$MS = (MD \quad)[1 - (M \times 10^{-2})] + 18\ (M \times 10^{-2})$

$MS = ($ ~~[illegible]~~ 31.73 $)[1 - (\ .142\ )] + 18\ (\ .142\ )$ = ~~[illegible]~~ 29.78

VELOCITY

Pitot tube coefficient, type S = CP = 0.78

Average Absolute Stack Temp. (°F + 460) = T_s = 606.4 °R

Average of the square root of Δp = $\sqrt{\Delta p}$ = 0.553 $(\text{in.}H_2O)^{1/2}$

Absolute pressure of stack $\left(BP \pm \frac{p}{13.6}\right)$ = P_s = 23.99 in.Hg

Stack gas velocity = V_s

$$V_s = (85.48)\ (\ CP\ ) \left[\sqrt{\frac{(\ T_s\ )}{(\ P_s\ )\ (\ MS\ )}}\right] \left[\sqrt{\Delta p}\right]$$

$$V_s = (85.48)\ (\ 0.78\ ) \left[\sqrt{\frac{(\ 606.4\ )}{(\ 23.99\ )\ (\ 29.78\ )}}\right] \left[\ .553\ \right]$$

= 33.97 FPS

ISOKINETIC PERCENT

Average pressure drop across orifice = ΔH = 0.739 in.H_2O

Total sampling time = T = 60 min.

Diameter of nozzle = d = .240 in.

Area of nozzle = A

$A = 54.54 \times 10^{-4}\ (d^2) = 54.54 \times 10^{-4}\ (\quad)^2$ = 3.14×10^{-4} sq. ft

I = percent Isokinetic

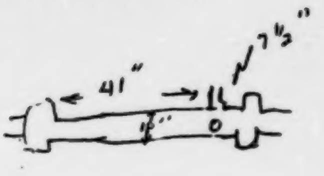
$$I = \frac{(1.667)\ (\ T_s\ )\left[0.00267\ (V_L\ ) + \frac{(\ V_m\ )}{(\ T_m\ )}\left(PB + \frac{(\ \Delta H\ )}{13.6}\right)\right]}{(\ T\ )\ (\ V_s\ )\ (\ P_s\ )\ (\ A\ )}$$

$$I = \frac{(1.667)\ (606.4)\left[0.00267\ (87.9) + \frac{(34.146)}{(567.9)}\left(23.62 + \frac{(\ 0.739\ )}{13.6}\right)\right]}{(\ 60\ )(\ 33.97\ )(\ 23.99\ )(\ 3.14 \times 10^{-4}\ )}$$

I = 109.1 %

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Geokinetics
DATE 7/20/79
SAMPLING LOCATION Outlet demister
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) ________
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) ________
STACK I.D., (DISTANCE A - DISTANCE B) 10"
NEAREST UPSTREAM DISTURBANCE ________
NEAREST DOWNSTREAM DISTURBANCE ________
CALCULATOR ________



SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.067	10"	3/4"	6 3/4"	7 1/2
2	.25	"	2 1/2"	"	9 1/4
3	.75	"	7 1/2"	"	14 1/4
4	.933	"	9 1/4"	"	16"
			3/4	11 3/4	12 1/2
			2 1/2	11 3/4	14 1/4
			7 1/2	11 3/4	19 1/4
			9 1/4	11 3/4	21"

EPA (Dur) 232
4/72

PRELIMINARY VELOCITY TRAVERSE

PLANT Geokinetics
DATE 7/20/79
LOCATION Outlet Demister
STACK I.D. 10"
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O -.04
OPERATORS Sterling Cash

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1	.12	119
2	.19	120
3	.23	121
4	.24	121
AVERAGE		

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
4/72

In stack wet bulb-dry bulb moisture calculation:

Plant Geokinetics Location Outlet Demister

Stack ____ Run 2 Date 7/20/79

Operators Sterling, Cash

Barometric Pressure (Hg) = BP = 23.64 in Hg

Static Pressure (in H_2O) P = -.04 in H_2O

Absolute Pressure of Stack = $BP \pm \frac{P}{13.6}$ .003 = P_s = 23.64 in Hg

Wet Bulb Temperature (°F) = T_w = 119 °F

Dry Bulb Temperature (°F) = T_d = 121 °F

Temp Difference ($T_d - T_w$) = ΔT = 2 °F

Vapor Pressure of H_2O at T_w (from table) VP = 3.351 in Hg

Partial Pressure of H_2O = PP

$$PP = (\quad VP) - \frac{(P_s - VP)(\Delta T)}{2800 - (1.3)(T_w)}$$

$$PP = (3.351) - \frac{(23.64 - 3.351)(2)}{2800 - (1.3)(119)} = 3.336 \text{ in Hg}$$

% Moisture by volume = M

$$M = \left(\frac{PP}{P_s}\right)(100) = \left(\frac{3.336}{23.64}\right)(100) = 14.1 \%$$

VAPOR PRESSURES OF WATER

°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg	°F	"Hg
0	.0376	33	.1878	53	.4052	73	.8183	93	1.561	113	2.829	133	4.900	153	8.150	173	13.07	193	20.27
2	.0417	34	.1955	54	.4203	74	.8462	94	1.610	114	2.911	134	5.031	154	8.351	174	13.37	194	20.70
4	.0463	35	.2035	55	.4359	75	.8750	95	1.660	115	2.995	135	5.165	155	8.557	175	13.67	195	21.14
6	.0517	36	.2118	56	.4520	76	.9046	96	1.712	116	3.081	136	5.302	156	8.767	176	13.98	196	21.59
8	.0571	37	.2203	57	.4686	77	.9352	97	1.765	117	3.169	137	5.442	157	8.981	177	14.30	197	22.05
10	.0631	38	.2292	58	.4858	78	.9666	98	1.819	118	3.259	138	5.585	158	9.200	178	14.62	198	22.52
12	.0696	39	.2383	59	.5035	79	.9989	99	1.875	119	3.351	139	5.732	159	9.424	179	14.96	199	22.99
14	.0768	40	.2478	60	.5218	80	1.032	100	1.932	120	3.446	140	5.881	160	9.652	180	15.29	200	23.47
16	.0846	41	.2576	61	.5407	81	1.066	101	1.992	121	3.543	141	6.034	161	9.885	181	15.63	201	23.96
18	.0932	42	.2677	62	.5601	82	1.102	102	2.052	122	3.642	142	6.190	162	10.12	182	15.98	202	24.46
20	.1025	43	.2782	63	.5802	83	1.138	103	2.114	123	3.744	143	6.350	163	10.36	183	16.34	203	24.97
22	.1127	44	.2891	64	.6009	84	1.175	104	2.178	124	3.848	144	6.513	164	10.61	184	16.70	204	25.48
24	.1248	45	.3004	65	.6222	85	1.213	105	2.243	125	3.954	145	6.680	165	10.86	185	17.07	205	26.00
26	.1370	46	.3120	66	.6442	86	1.253	106	2.310	126	4.063	146	6.850	166	11.12	186	17.44	206	26.53
27	.1429	47	.3240	67	.6669	87	1.293	107	2.379	127	4.174	147	7.024	167	11.38	187	17.82	207	27.07
28	.1502	48	.3364	68	.6903	88	1.335	108	2.449	128	4.289	148	7.202	168	11.65	188	18.21	208	27.62
29	.1567	49	.3493	69	.7144	89	1.378	109	2.521	129	4.406	149	7.384	169	11.92	189	18.61	209	28.18
30	.1647	50	.3626	70	.7392	90	1.422	110	2.596	130	4.525	150	7.569	170	12.20	190	19.01	210	28.75
31	.1716	51	.3764	71	.7648	91	1.467	111	2.672	131	4.647	151	7.759	171	12.48	191	19.42	211	29.33
32	.1803	52	.3906	72	.7912	92	1.513	112	2.749	132	4.772	152	7.952	172	12.77	192	19.84	212	29.92

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DRY MOLECULAR WEIGHT DETERMINATION

PLANT Geokinetics
DATE 7-20-79
SAMPLING TIME (24-hr CLOCK) 10:08 AM
SAMPLING LOCATION Outlet RUN #1
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 95°
OPERATOR W. McDONALD

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	23.8	23.8	23.8	23.8				44/100	10.4
O_2(NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	25.2	1.4	25.2	1.4				32/100	0.8 ~~[illegible]~~
CO(NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	31.0	5.8	31.0	5.8				28/100	1.6 ~~[illegible]~~
N_2(NET IS 100 MINUS ACTUAL CO READING)		69.0		69.0				28/100	19.3
								TOTAL	36.8

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EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Geo Kinetics
DATE 7/21/79
SAMPLING TIME (24-hr CLOCK) 1320
SAMPLING LOCATION Outlet Process Gas Run#3
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 82°
OPERATOR W. McDonald

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	19.8	19.8	19.8	19.8	19.8	19.8	19.8	44/100	8.712
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	22.8	3.0	22.8	3.0	22.8	3.0	3.0	32/100	0.96
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	28.0	5.2	27.8	5.0	28.0	5.2	5.13	28/100	1.44
N_2 (NET IS 100 MINUS ACTUAL CO READING)							72.07	28/100	20.18
								TOTAL	31.29

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Geokinetics

DATE 7-20-79

SAMPLING TIME (24-hr CLOCK) 3:50 Pm 1650

SAMPLING LOCATION Outlet Run # 2

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 87

OPERATOR W. McDonald

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	23.0	23.0	23.0	23.0	23.0	23.0	23.0	44/100	10.1
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	25.2	2.2	25.3	2.3	25.3	2.3	2.3	32/100	0.7
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	29.6	4.4	29.7	4.4	29.7	4.4	4.4	28/100	1.2
N_2 (NET IS 100 MINUS ACTUAL CO READING)							80.3	28/100	~~24.6~~ [illegible]
								TOTAL	~~36.6~~ 31.7

EPA (Dur) 230
4/72

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best available copy.

NOMOGRAPH DATA (HP-65)

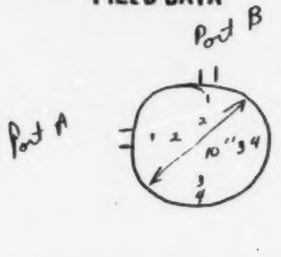
PLANT Geokinetic
DATE 7/20/79
SAMPLING LOCATION Outlet Demister

USED ON RUN NO.: 2
CALCULATOR: Sterling

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Run card			—
2	Initialize program		A	0.00
3	Enter average T_m (meter temp. °F + 460) If meter temp. unknown, use ambient + 20°F	570 °R	R/S	T_m 551
4	Enter P_m (Barometric pressure at meter)	23.64 In. Hg	R/S	T_m/P_m ✓
5	Enter P_s (static pressure in stack) [P_m ± .073 x stack gauge pressure in In. H_2O]	23.64 In. Hg	R/S	P_s ✓
6	Enter average T_s (stack temperature + 460)	581 °R	R/S	P_s/T_s 581
7	Enter B_{ms} (mole fraction of H_2O vapor in gas stream)	.141 Fraction of H_2O	R/S	Fraction Dry .17
8	Enter MD (molecular weight of dry gas)	32.81 lbs/lb mole	R/S	MW molecular wt of stack gas lbs/lb mole 3[illegible].75
9	Enter Cp (type "S" pitot tube coefficient)	.78	R/S	.78
10	Enter average Δ_p Highest Δ_p (________)	.20 In. H_2O	R/S	D_n theo. (nozzle dia. in inches) .32
11	Initialize "B"	—	B	—
12	Enter actual D_n	.305 In.	R/S	—
13	Enter $\Delta H_@$ (Calibrated pressure differential across orifice)	1.785 In. H_2O	R/S	6.56 6.17 K factor
14_1	Enter actual Δ_{p_1} .16	.16	E	ΔH_1 .988 In. H_2O
14_2	Enter actual Δ_{p_2}	.25	E	ΔH 1.54 In. H_2O
14_3	Enter actual Δ_{p_3}		E	ΔH In. H_2O

FIELD DATA

PLANT Geokinetics
DATE 7/20/79
SAMPLING LOCATION Outlet Demister
SAMPLE TYPE EPA #5 - Modified
RUN NUMBER #2 (5-2)
OPERATOR Sterling
AMBIENT TEMPERATURE 90°F
BAROMETRIC PRESSURE 23.64
STATIC PRESSURE, (P_s) -.04
FILTER NUMBER (s) 206651-19



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 8' S.S.
NOZZLE I.D. .305
ASSUMED MOISTURE, % 14.1
SAMPLE BOX NUMBER 1
METER BOX NUMBER 6
METER $\Delta H_@$ 1.785
C FACTOR
PROBE HEATER SETTING med.
HEATER BOX SETTING med.
REFERENCE Δp ΔP=1 = 6.56-ΔH
Before .003 cfm @ 15" Hg

READ AND RECORD ALL DATA EVERY 5 MINUTES LEAK RATE .02 CFM @13" "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	Probe
	00	1230	463107										
1	0	1230	463.107	.16	1.05	1.05	120	93	92	3.5	254	69	275
	5	1235	466.754	.16	1.05	1.05	120	99	92	3.2	256	68	276
	10	1240	470.250	.16	1.05	1.05	120	97	93	3.9	251	68	277
2	15	1245	473.445	.18	1.18	1.18	120	97	93	4.5	245	69	276
	20	1250	476.945	.18	1.18	1.18	121	97	93	4.5	242	70	277
	25	1255	480.521	.18	1.18	1.18	120	97	92	4.8	237	70	276
3	30	1300	484.122	.19	1.25	1.25	122	97	92	5.2	243	69	274
	35	1305	487.778	.21	1.37	1.37	121	97	92	5.5	245	69	275
	40	1310	491.610	.22	1.44	1.44	121	96	92	5.5	238	69	272
4	45	1315	495.546	.24	1.57	1.57	121	95	92	6.0	244	70	274
	50	1320	499.632	.24	1.57	1.57	121	95	92	6.0	253	69	272
	55	1325	503.756	.24	1.57	1.57	122	96	92	6.0	247	70	273
1	60	1330	507.917	.19	1.25	1.25	122	89	90	5.5	222	65	236
	65	1401	511.510	.19	1.25	1.25	121	88	89	5.8	227	63	247
	70	1406	515.200	.19	1.25	1.25	120	88	89	5.8	239	65	254
2	75	1411	518.910	.21	1.37	1.37	120	89	88	5.9	240	64	259

Port A
Port B

PLANT Geokinetic's **DATE** 7/20/79 **RUN NO.** 2 (5-2) Outlet Demister

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	Probe
					DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
	75	1411	518.910										
2 cont.	80	1416	522.700	.21	1.37	1.37	121	89	88	5.9	241	65	260
	85	1421	526.500	.21	1.37	1.37	122	90	87	6.0	247	66	262
3	90	1426	530.280	.24	1.64	1.64	121	91	87	6.4	245	65	264
	95	1431	535.000	.25	1.64	1.64	122	91	87	6.5	243	66	266
	100	1436	538.565	.25	1.64	1.64	122	91	87	6.5	243	66	266
4	105	1441	542.745	.25	1.64	1.64	122	90	87	7.0	242	66	267
	110	1446	546.660	.25	1.64	1.64	122	89	87	8.0	246	66	260
	115	1451	551.000	.25	1.64	1.64	122	89	87	8.7	251	67	200
	120	1456	555.058										
		120	91.951	√0.457		1.382	121.08	91.35					

CLEAN-UP DATA

Plant Geokinetics

Comments:

Date 7/20/79

Sampling Location outlet Demister

Sample Type Mod meth 5

Run Number 5-22

Sample Box Number

Clean-up Man D.S. - Lnc.

IMPINGERS

oil bed - water 8 ml.

	#1		#2		#3		#4		#5	
Final Vol.	~~240~~ 306	ml	248	ml	206	ml		ml		ml
Initial Vol.	100	ml	200	ml	200	ml		ml		ml
Net Vol.	206	ml	48	ml	06	ml		ml		ml

Total Net Volume in Impingers ______ ml

SILICA GEL

Final Weight	246.4	g		g		g
Initial Weight	200.0	g		g		g
Net Weight	46.4	g		g		g

Si Gel - black & oily in appearance -

Total Net Weight in Silica Gel ______ g

Total Moisture ______ g

Filter Number(s) 206651-19

Filter holder was capped & marked because we could not get it clean.

MRC 7/73

ISOKINETIC CALCULATION

Plant Geokinetics

Run# 2 Outlet of Demist. Date 7/20/79

Location Outlet, Initials WAF

MOISTURE

Net volume of liquid collected in impingers and silica gel $= V_L =$ 306.4 ml

Net volume of gas through dry gas meter at meter conditions $= V_m =$ 91.951 cu.ft.

Barometric Pressure - absolute = BP = 23.64 in.Hg

Average absolute meter temperature (°F + 460) $= T_m =$ ~~91.35~~ 551.35 °R

Percent moisture = M

$$M = \frac{100}{1 + \frac{373.63\,(\ V_m\ )\,(\ BP\ )}{(\ T_m\ )\,(\ V_L\ )}}$$

$$= \frac{100}{1 + \frac{373.63\,(\ 91.951\ )\,(\ 23.64\ )}{(\ \cancel{91.35}\ 551.35\ )\,(\ 306.4\ )}} = \cancel{3.33}\ 17.22\ \%$$

MOLECULAR WEIGHT

Percent O_2 by volume dry basis $= O_2 =$ ______ %

" CO " " " " $= CO =$ ______ %

" CO_2 " " " " $= CO_2 =$ ______ %

$N_2 = 100 - (O_2 + CO_2 + CO) = 100 - (\quad + \quad + \quad)$

Percent N_2 by volume dry basis $= N_2 =$ ______ %

Dry molecular weight = MD

$MD = 0.44\,(\ CO_2\ ) + 0.32\,(\ O_2\ ) + 0.28\,(\ N_2 + CO\ )$

$MD = 0.44\,(\quad) + 0.32\,(\quad) + 0.28\,(\quad + \quad)$

MD = 31.75

ISOKINETIC CALCULATION (Cont.d)

MOLECULAR WEIGHT (Cont.d)

Stack gas molecular weight = MS

MS = (MD)[1 - (M x 10^{-2})] + 18 (M x 10^{-2})

MS = (31.75)[1 - (~~.0333~~ .17.22)] + 18 (~~.0333~~ .17.22) = ~~31.272~~ 29.38

VELOCITY

Pitot tube coefficient, type S = CP = 0.78

Average Absolute Stack Temp. (°F + 460) = T_s = 581.08 °R

Average of the square root of Δp = $\sqrt{\Delta p}$ = 0.457 $(\text{in.}H_2O)^{1/2}$

Absolute pressure of stack (BP ± $\frac{P}{13.6}$) = P_s = 23.64 in.Hg

Stack gas velocity = V_s

$$V_s = (85.48)\,(\ CP\ )\left[\sqrt{\frac{(\ T_s\ )}{(\ P_s\ )\,(\ MS\ )}}\right]\left[\sqrt{\Delta p}\right]$$

$$V_s = (85.48)\,(\ 0.78\ )\left[\sqrt{\frac{(\ 581.08\ )}{(\ 23.64\ )\,(\ \cancel{31.272}\ \ 29.38\ )}}\right]\left[\ .457\ \right]$$

= ~~27.006~~ 27.87 FPS

ISOKINETIC PERCENT

Average pressure drop across orifice = ΔH = 1.382 in.H_2O

Total sampling time = T = 120 min.

Diameter of nozzle = d = ~~[illegible]~~ .305 in.

Area of nozzle = A

A = 54.54 x 10^{-4} (d^2) = 54.54 x 10^{-4} ($)^2$ = ~~3.[illegible]~~ 5.074x10^{-4} sq. ft

I = percent Isokinetic

$$I = \frac{(1.667)\,(\ T_s\ )\left[0.00267\,(V_L\ ) + \frac{(\ V_m\ )}{(\ T_m\ )}\left(PB + \frac{(\ \Delta H\ )}{13.6}\right)\right]}{(\ T\ )\ (\ V_s\ )\ (\ P_s\ )\ (\ A\ )}$$

$$I = \frac{(1.667)\,(\ 581.08\ )\left[0.00267\,(306.4) + \frac{(91{,}951)}{(\ \cancel{[illegible]}\ 551.35\ )}\left(23.64 + \frac{(\ 1.382\ )}{13.6}\right)\right]}{(\ 120\ )(\ \cancel{22.006}\ 27.87\ )(\ 23.64\ )(\ \cancel{3.[illegible]\times 10^{-4}}\ 5.074\times10^{-4}\ )}$$

I = ~~[illegible]~~ 115.36 %

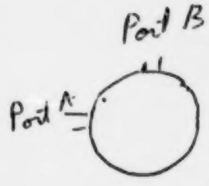
NOMOGRAPH DATA (HP-65)

PLANT Geo[illegible]
USED ON RUN NO.: 1
DATE 7/22/79
CALCULATOR: [illegible]
SAMPLING LOCATION ~~Inlet~~ Outlet Demister

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Run card			—
2	Initialize program		A	0.00
3	Enter average T_m (meter temp. °F + 460) If meter temp. unknown, use ambient + 20°F	555 °R	R/S	T_m
4	Enter P_m (Barometric pressure at meter)	23.60 In. Hg	R/S	T_m/P_m
5	Enter P_s (static pressure in stack) [P_m ± .073 x stack gauge pressure in In. H_2O] -.04	23.597 In. Hg	R/S	P_s
6	Enter average T_s (stack temperature + 460)	581 °R	R/S	P_s/T_s
7	Enter B_{ms} (mole fraction of H_2O vapor in gas stream)	.17 Fraction of H_2O	R/S	Fraction Dry
8	Enter MD (molecular weight of dry gas)	31.75 lbs/lb mole	R/S	MW molecular wt of stack gas lbs/lb mole
9	Enter C_p (type "S" pitot tube coefficient)	.78	R/S	
10	Enter average Δ_p Highest Δ_p (________)	.21 In. H_2O	R/S	D_n theo. (nozzle dia. in inches) .321
11	Initialize "B"	—	B	—
12	Enter actual D_n	.305 In.	R/S	—
13	Enter $\Delta H_@$ (Calibrated pressure differential across orifice)	1.785 In. H_2O	R/S	K factor 5.67
14_1	Enter actual Δ_{p_1}		E	ΔH_1 In. H_2O
14_2	Enter actual Δ_{p_2}		E	ΔH In. H_2O
14_3	Enter actual Δ_{p_3}		E	ΔH In. H_2O

FIELD DATA

PLANT Geokinetics
DATE 7/22/79
SAMPLING LOCATION Outlet Demister
SAMPLE TYPE Modified EPA #5
RUN NUMBER 4 5-4
OPERATOR Sterling ; Cash
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 23.60
STATIC PRESSURE, (P_s) -.04
FILTER NUMBER (s) 2066 5r 21



PROBE LENGTH AND TYPE 8" S.S.
NOZZLE I.D. .305
ASSUMED MOISTURE, % .17
SAMPLE BOX NUMBER 1
METER BOX NUMBER 6
METER $\Delta H_@$ 1.785
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp 5.67·ΔH = 1.0Δp

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES LEAK RATE .005 CFM @ 6 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
					DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
		10:45	642.135										
1	0	10:45	642.135	~~.16~~ .17	.96	.96	129	92	91	3.0	246	73	180
*	5	10:50	645.345	.17	.96	.96	124	93	91	3.0	248	72	250
	10	11:09	648.766	.17	.96	.96	125	98	91	3.0	238	70	290
2	15	11:14	651.945	.17	.96	.96	129	99	91	3.1	245	70	293
	20	11:19	655.135	.17	.96	.96	124	98	92	3.1	234	71	292
	25	11:24	658.320	.17	.96	.96	123	99	92	3.2	238	73	309
3	30	1129	661.507	.19	1.08	1.08	122	99	92	3.2	241	76	290
	35	1134	664.943	.19	1.08	1.08	123	98	92	3.6	238	70	277
	40	1139	668.387	.19	1.08	1.08	123	98	92	3.6	238	71	275
4	45	1144	671.815	.21	1.19	1.19	124	99	93	3.8	242	72	262
	50	1149	675.315	.21	1.19	1.19	124	99	93	3.9	240	73	269
	55	1154	678.945	.21	1.19	1.19	125	99	99	4.0	242	75	260
1	60	1159	682.580	.14	.79	.79	124	96	99	3.2	220	77	263
	65	1215	685.570	.13	.74	.74	123	97	93	3.5	246	77	279
	70	1220	688.350	.14	.79	.79	124	98	93	3.5	246	77	277
2	75	1225	691.265	.16	.91	.91	124	99	93	3.2	243	77	283

* Down to change variac for probe heat

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PLANT Geokinetics DATE 7/22/79 RUN NO. 4 (5-4)

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
					DESIRED	ACTUAL		INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F				
	75	1225	691.265										
	80	1230	694.810	.16	.91	.91	124	98	95	3.9	248	77	295
	85	1235	697.438	.16	.91	.91	123	97	93	3.9	253	77	307
3	90	1240	700.560	.19	1.08	1.08	124	98	94	4.1	250	77	319
	95	1245	703.985	.19	1.08	1.08	124	98	93	4.1	271	78	317
	100	1250	707.425	.19	1.08	1.08	124	98	92	4.1	237	80	322
4	105	1255	710.865	.20	1.13	1.13	124	99	94	4.2	247	79	324
	110	1300	714.320	.20	1.13	1.13	125	99	93	4.2	247	79	320
	115	1305	717.865	.20	1.13	1.13	125	100	93	4.5	259	80	283
	120	1310	721.405										
			79.27	$\sqrt{\Delta P}$= .421		1.01	123.9	95.25					

CLEAN-UP DATA

Plant Geokinetics
Date 7/22/79
Sampling Location After Demister
Sample Type Mod Meth 5
Run Number 5-4
Sample Box Number 1
Clean-up Man D.S. + LNC

Comments:

IMPINGERS

	#1 - oil & oil water	#2	#3	#4	#5
Final Vol.	268 ml	228 ml	201 ml	ml	ml
Initial Vol.	100 ml	200 ml	200 ml	ml	ml
Net Vol.	168 ml	28 ml	01 ml	ml	ml

Total Net Volume in Impingers 197 ml

SILICA GEL

Final Weight	399.3 g	g	g
Initial Weight	250 g	g	g
Net Weight	74.3 g	g	g

- Si Black + oily in appearance - saved -

Total Net Weight in Silica Gel ~~271.3~~ 74.3 g

Total Moisture 271.3 g

Filter Number(s) 206651-21

MRC 7/73

ISOKINETIC CALCULATION

Plant Soohutes

Run# 5-4, Date 7/22/79

Location Outlet Demister, Initials WF

MOISTURE

Net volume of liquid collected in impingers and silica gel = V_L = 271.3 ml

Net volume of gas through dry gas meter at meter conditions = V_m = 79.27 cu.ft.

Barometric Pressure - absolute = BP = 23.60 in.Hg

Average absolute meter temperature (°F + 460) 95.25+460 = T_m = 555.3 °R

Percent moisture = M

$$M = \frac{100}{1 + \dfrac{373.63\,(\ V_m\ )\,(\ BP\ )}{(\ T_m\ )\,(\ V_L\ )}}$$

$$= \frac{100}{1 + \dfrac{373.63\,(\ 79.27\ )\,(\ 23.60\ )}{(\ 555.3\ )\,(\ 271.3\ )}} = 17.7\ \%$$

MOLECULAR WEIGHT

Percent O_2 by volume dry basis = O_2 = ________ %

" CO " " " " = CO = ________ %

" CO_2 " " " " = CO_2 = ________ %

$N_2 = 100 - (O_2 + CO_2 + CO) = 100 - (\quad + \quad + \quad)$

Percent N_2 by volume dry basis = N_2 = ________ %

Dry molecular weight = MD

$MD = 0.44\,(\ CO_2\ ) + 0.32\,(\ O_2\ ) + 0.28\,(\ N_2 + CO\ )$

$MD = 0.44\,(\quad) + 0.32\,(\quad) + 0.28\,(\quad + \quad)$

MD = [illegible]

ISOKINETIC CALCULATION (Cont.d)

MOLECULAR WEIGHT (Cont.d)

Stack gas molecular weight = MS

$$MS = (MD \quad)[1 - (M \times 10^{-2})] + 18\,(M \times 10^{-2})$$

$$MS = (31.6 \quad)[1 - (.177 \quad)] + 18\,(.177 \quad) = \underline{29.20}$$

$$26.01 \qquad + 3.19$$

VELOCITY

Pitot tube coefficient, type S = CP = ,78

Average Absolute Stack Temp. (°F + 460) = T_s = 583.9 °R

Average of the square root of Δp = $\sqrt{\Delta p}$ = .421 $(\text{in.}H_2O)^{1/2}$

Absolute pressure of stack $\left(BP \pm \frac{P}{13.6}\right)$ = P_s = 23.60 in.Hg

Stack gas velocity = V_s

$$V_s = (85.48)\,(\ CP\ )\left[\sqrt{\frac{(\ T_s\ )}{(\ P_s\ )\,(\ MS\ )}}\right]\left[\sqrt{\Delta p}\right]$$

$$V_s = (85.48)\,(\ .78\ )\left[\sqrt{\frac{(\ 583.9\ )}{(\ 23.60\ )\,(\ 29.20\ )}}\right]\left[,421\right]$$

$$= \underline{25.84}\ \text{FPS}$$

ISOKINETIC PERCENT

Average pressure drop across orifice = ΔH = 1.01 in.H_2O

Total sampling time = T = 120 min.

Diameter of nozzle = d = .305 in.

Area of nozzle = A

$$A = 54.54 \times 10^{-4}\,(d^2) = 54.54 \times 10^{-4}\,(.305)^2 = \underline{5.074 \times 10^{-4}}\ \text{sq. ft}$$

I = percent Isokinetic

$$I = \frac{(1.667)\,(\ T_s\ )\left[0.00267\,(V_L\ ) + \frac{(\ V_m\ )}{(\ T_m\ )}\left(PB + \frac{(\ \Delta H\ )}{13.6}\right)\right]}{(\ T\ )\,(\ V_s\ )\,(\ P_s\ )\,(\ A\ )}$$

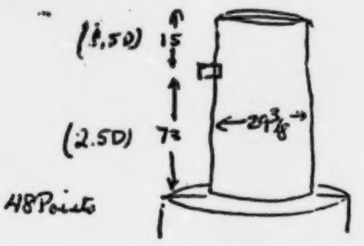
$$I = \frac{(1.667)\,(583.9)\left[0.00267\,(271.3) + \frac{(79.27)}{(555.3)}\left(23.60 + \frac{(\ 1.01\ )}{13.6}\right)\right]}{(\ 120\ )(\ 25.84\ )(\ 23.60\ )\ (\ 5.074 \times 10^{-4}\ )}$$

126 MIN.

I = 107.6 %

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Geokinetics
DATE 7/21/79
SAMPLING LOCATION Incinerator Stack
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 32 5/8
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 3 1/4
STACK I.D., (DISTANCE A - DISTANCE B) 29 3/8
NEAREST UPSTREAM DISTURBANCE 73"
NEAREST DOWNSTREAM DISTURBANCE 15"
CALCULATOR WRF



SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	,011	29,375	3/8 adj to 1"	~~3 7/8~~"	(13 1/4) ~~4 1/4~~ 8 5/8
2	,032		7/8 adj to 1"	7 5/8	(13 1/4) ~~4 1/4~~ 8 5/8
3	,055		1 5/8		(13 7/8) ~~4 7/8~~ 9 2/8
4	,079		2. 3/8		([illegible]) ~~5 5/8~~ 10
5	,105		3 1/8		([illegible]) ~~6 3/8~~ 10 6/8
6	,132		3 7/8		([illegible]) ~~7 1/8~~ 11 4/8
7	,161		4 3/4		(17.0) ~~8~~ 12 3/8
8	,194		5 3/4		(18.0) ([illegible]) ~~9~~ 13 3/8
9	.230		6 3/4		(19.0) ([illegible]) ~~10~~ 14 3/8
10	,272		8		([illegible]) ~~11 1/4~~ 15 5/8
11	,323		9 1/2		([illegible]) ~~12 3/4~~ 17 1/8
12	,398		11 3/4		(24) ~~15~~ 19 3/8
13	,602		17 5/8		([illegible]) ~~20 7/8~~ 25 4/8
14	,677		19 7/8		([illegible]) ~~23 1/8~~ 27 4/8
15	.728		21 3/8		~~24 5/8~~ 29
16	,770		22 5/8		~~25 7/8~~ 30 2/8
17	,806		23 5/8		~~26 7/8~~ 31 2/8
18	.839		24 5/8		~~27 7/8~~ 32 2/8
19	,868		25 1/2		~~28 3/4~~ 33 1/8
20	,895		26 1/4		~~29 1/2~~ 33 7/8
21	,921		27.0		~~30 1/4~~ 34 5/8
22	,945		27 3/4		~~31~~ 35 3/8
23	.968		28 1/2 adj to [illegible]		~~31 5/8~~ 36
24	,989		29 adj to 28 3/4		~~31 5/8~~ 36

EPA (Dur) 232
4/72

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TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Geokinetics
DATE 7/21/79
SAMPLING LOCATION Incinerator Stack
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A)
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B)
STACK I.D., (DISTANCE A - DISTANCE B)
NEAREST UPSTREAM DISTURBANCE
NEAREST DOWNSTREAM DISTURBANCE
CALCULATOR

Calc for marking Probe

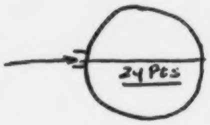
SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE. (SUM OF COLUMNS 4 & 5)
1			3/8 adj to 1"	12 1/4	13 1/4
2			7/8 adj to 1"		13 1/4
3			1 5/8		13 7/8
4			2 3/8		14 5/8
5			3 1/8		15 3/8
6			3 7/8		16 1/8
7			4 3/4		17
8			5 3/4		18
9			6 3/4		19
10			8		20 1/4
11			9 1/2		21 3/4
12			11 3/4		24
13			17 5/8		29 7/8
14			19 7/8		32 1/8
15			21 3/8		33 5/8
16			22 5/8		34 7/8
17			23 5/8		35 7/8
18			24 5/8		36 7/8
19			25 1/2		37 3/4
20			26 1/4		38 1/2
21			27		39 1/4
22			[illegible]		40
23			[illegible]		40 5/8
24			27 adj to 28 5/8		40 5/8

EPA (Dur) 232
4/72

PRELIMINARY VELOCITY TRAVERSE

PLANT [illegible]
DATE 7/21/79
LOCATION Incinerator Stack
STACK I.D. 29 3/8
BAROMETRIC PRESSURE, in. Hg 23.62
STACK GAUGE PRESSURE, in. H_2O −.08
OPERATORS



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1	.06	1100
2	.05	1115
3	.05	1128
4	.06	1175
5	.06	1175
6	.07	1178
7	.075	1192
8	.085	1210
9	.075	1220
10	.09	1229
11	.095	1240
12	.08	1240
13	.085	1245
14	.090	1242
15	0.10	1240
16	0.10	1242
17	0.105	1238
18	0.110	1232
19	0.120	1235
20	0.115	1221
21	0.110	1211
22	0.105	1190
23	0,110	1198
24	0.110	1198
AVERAGE	.088	1203.5

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT GeoKineticies
DATE 7-21-79
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION Incinerator Stack
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE
OPERATOR W

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	44/100	5.37
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	16.8	4.6	17.2	5.0	17.2	5.0	4.87	32/100	1.56
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	16.8	0	17.2	0	17.2	0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		83.2		82.80		82.80	82.93	28/100	23.22
								TOTAL	30.15

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT GeoKinetics
DATE 7/21/79
SAMPLING TIME (24-hr CLOCK) Sample #2 1540 (3:40 Pm)
SAMPLING LOCATION Incinerator outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 80
OPERATOR W. McDaniel

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	9.6	9.6	10.0	10.0	9.8	9.8	9.8	44/100	4.31
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	15.8	6.2	15.8	5.8	15.8	6.0	6.0	32/100	1.92
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	15.8	0	15.8	0	15.8	0	0	28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							84.2	28/100	23.58
								TOTAL	29.81

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Geokinetics
DATE 7/21/79
SAMPLING TIME (24-hr CLOCK) 4 45 pm
SAMPLING LOCATION Incinerator outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) Bag
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 80° Stack Temp 1300F
OPERATOR W. McDonald

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	10.0	10.0	10.0	10.0	9.8	9.8	9.93	44/100	4.37
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	15.2	5.2	15.2	5.2	15.0	5.2	5.2	32/100	1.66
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	15.2	0	15.2	0	15.0	0	0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)							84.9	28/100	23.76
								TOTAL	29.79

EPA (Dur) 230
4/72

NOMOGRAPH DATA (HP-65)

PLANT Geolantics

USED ON RUN NO.: 5-3

DATE 7/21/79

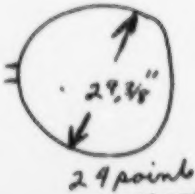
CALCULATOR: URF

SAMPLING LOCATION Incinerator Stack

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS	
1	Run card			—	
2	Initialize program		A	0.00	
3	Enter average T_m (meter temp. °F + 460) If meter temp. unknown, use ambient + 20°F	100 + 460 = °R 560	R/S	T_m	[illegible] 559.
4	Enter P_m (Barometric pressure at meter)	.356 23.62 In. Hg	R/S	T_m/P_m	23.6
5	Enter P_s (static pressure in stack) [P_m ± .073 x stack gauge pressure in In. H_2O] −.08	23.614 23.614 In. Hg	R/S	P_s	23.6
6	Enter average T_s (stack temperature + 460) 1203.5 + 460	1663.5 °R	R/S	P_s/T_s	.711
7	Enter B_{ms} (mole fraction of H_2O vapor in gas stream)	.12 Fraction of H_2O	R/S	Fraction Dry	.103
8	Enter MD (molecular weight of dry gas)	30.15 lbs/lb mole	R/S	MW molecular wt of stack gas lbs/lb mole	29.6
9	Enter C_p (type "S" pitot tube coefficient)	.78 —	R/S		.78
10	Enter average Δ_p Highest Δ_p (.120)	.088 In. H_2O	R/S	D_n theo. .4995 (nozzle dia. in inches)	56
11	Initialize "B"	—	B	—	
12	Enter actual D_n	.483 In.	R/S	—	
13	Enter $\Delta H_@$ (Calibrated pressure differential across orifice)	1.785 In. H_2O	R/S	13.76 K factor	13.6
14_1	Enter actual Δ_{p_1}	.088	E	ΔH_1 1.21 In. H_2O	
14_2	Enter actual Δ_{p_2}	.120	E	ΔH 1.65 In. H_2O	
14_3	Enter actual Δ_{p_3}	.05	E	ΔH .688 In. H_2O	

FIELD DATA

PLANT Geokinetics
DATE 7/21/79
SAMPLING LOCATION Incinerator Stack
SAMPLE TYPE Particulate /Trace Metal
RUN NUMBER 3-3
OPERATOR DS + LC
AMBIENT TEMPERATURE 87
BAROMETRIC PRESSURE 23.62
STATIC PRESSURE, (P_s) -.08
FILTER NUMBER (s) 206651-20



24 points across one port

SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 8" S.S
NOZZLE I.D. .483
ASSUMED MOISTURE, % 12%
SAMPLE BOX NUMBER 1
METER BOX NUMBER 6
METER $\Delta H_@$ 1.785
C FACTOR
PROBE HEATER SETTING 300
HEATER BOX SETTING 250
REFERENCE Δp ΔP=.1 - ΔH=13.26

READ AND RECORD ALL DATA EVERY 5 MINUTES LEAK RATE .016 CPM @ 8 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	Probe
					DESIRED	ACTUAL		INLET $(T_{m\,in})$, °F	OUTLET $(T_{m\,out})$, °F				
	00	15:30	555.618										
1	00	15:30	555.618	.06	.83	.83	1215	89	88	3.0	232	65	292'
2	5	15:35	558.578	.06	.83	.83	1216	93	89	3.0	243	65	308
3	10	1540	561.675	.07	.96	.96	1205	96	89	3.0	257	66	314
4	15	1545	564.561	.06	.83	.83	1215	97	90	3.0	255	67	322
5	20	1550	567.630	.06	.83	.83	1205	98	90	3.0	251	68	322
6	25	1555	570.585	.07	.96	.96	1206	98	91	3.0	249	69	324
7	30	1600	573.754	.07	.96	.96	1230	99	92	3.0	260	71	325
8	35	1605	576.920	.08	1.10	1.10	1230	99	93	3.0	255	72	332
9	40	1610	580.350	.09	1.24	1.29	1240	99	93	3.2	263	71	336
10	45	1615	583.945	.07	.96	.96	1237	98	92	3.0	260	71	340
11	50	1620	587.190	.08	1.10	1.10	1240	97	92	3.0	263	71	338
12	55	1625	590.545	.09	1.29	1.29	1262	99	92	3.2	274	69	338
13	60	1630	594.158	.09	1.24	1.24	1268	100	93	3.5	272	71	341
14	65	1635	597.800	.09	1.29	1.29	1285	99	92	3.5	267	72	340
15	70	1640	601.425	.10	1.38	1.38	1277	98	92	3.8	269	72	362
16	75	1645	605.240	.10	1.38	1.38	1275	98	92	3.8	261	70	370

PLANT Geokinetics **DATE** 7/21/79 **RUN NO.** 3 (5-3)

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
					DESIRED	ACTUAL		INLET $(T_{m_{in}})$, °F	OUTLET $(T_{m_{out}})$, °F				
	75	1645	605.240										
17	80	1650	609.069	.12	1.65	1.65	1275	98	92	4.0	264	69	373
18	85	1655	613.190	.12	1.65	1.65	1270	96	92	4.0	265	68	375
19	90	1700	617.370	.12	1.65	1.65	1280	95	91	4.0	270	70	342
20	95	1705	621.546	.11	1.51	1.51	1280	96	92	4.0	271	72	319
21	100	1710	626.558	.11	1.51	1.51	1285	97	92	4.0	267	71	308
22	105	1715	629.535	.11	1.51	1.51	1260	98	92	4.0	288	73	323
23	110	1720	633.505	.10	1.38	1.38	1285	98	92	4.0	274	73	304
24	115	1725	637.318	.11	1.51	1.51	1285	96	91	4.0	265	72	302
	120	1730	641.303										
				ΔP =.089									
AVG	120		85.685	$\sqrt{\Delta P}$ =.282		1.23	1251	97.13	94.17	3.45	262.3	69.9	330

CLEAN-UP DATA

Plant Geokinetics Comments:
Date 7/21/79
Sampling Location Incinerator Stack
Sample Type Mod Meth 5
Run Number 5-3
Sample Box Number 1
Clean-up Man D.S., JR, LMC

IMPINGERS

	#1	#2	#3	#4	#5
Final Vol.	222 ml	216 ml	201 ml	ml	ml
Initial Vol.	100 ml	200 ml	201 ml	ml	ml
Net Vol.	122 ml	16 ml	0 ml	ml	ml

Total Net Volume in Impingers 138 ml

SILICA GEL

Final Weight	266.1 g	g	g
Initial Weight	250.0 g	g	g
Net Weight	16.1 g	g	g

Total Net Weight in Silica Gel 16.1 g

Total Moisture 154.1 g

Filter Number(s) 20665I-20

MRC 7/73

ISOKINETIC CALCULATION

Plant Geokinetics

Run# 5-3, Date 7/21/79

Location Incinerator Stack, Initials URJ

MOISTURE

Net volume of liquid collected in impingers and silica gel $= V_L =$ 154.1 ml

Net volume of gas through dry gas meter at meter conditions $= V_m =$ 85.685 cu.ft.

Barometric Pressure - absolute = BP = 23.62 in.Hg

Average absolute meter temperature (°F + 460) 94.17+460 $= T_m =$ 554.17 °R

Percent moisture = M

$$M = \frac{100}{1 + \frac{373.63\,(V_m)\,(BP)}{(T_m)\,(V_L)}}$$

$$= \frac{100}{1 + \frac{373.63\,(85.685)\,(23.62)}{(554.17)\,(154.1)}} = 10.15\ \%$$

MOLECULAR WEIGHT

Percent O_2 by volume dry basis $= O_2 =$ ______ %

" CO " " " " $= CO =$ ______ %

" CO_2 " " " " $= CO_2 =$ ______ %

$N_2 = 100 - (O_2 + CO_2 + CO) = 100 - (\quad + \quad + \quad)$

Percent N_2 by volume dry basis $= N_2 =$ ______ %

Dry molecular weight = MD

$MD = 0.44\,(CO_2) + 0.32\,(O_2) + 0.28\,(N_2 + CO)$

$MD = 0.44\,(\quad) + 0.32\,(\quad) + 0.28\,(\quad + \quad)$

MD = 29.92

ISOKINETIC CALCULATION (Cont.d)

MOLECULAR WEIGHT (Cont.d)

Stack gas molecular weight = MS

$MS = (MD\ \ )[1 - (M \times 10^{-2})] + 18\ (M \times 10^{-2})$

$MS = (29.92)[1 - (.1015)] + 18\ (.1015) =$ 28.71

VELOCITY

Pitot tube coefficient, type S = CP = 0.78

Average Absolute Stack Temp. (°F + 460) = T_s = 1711.0 °R

Average of the square root of Δp = $\sqrt{\Delta p}$ = .282 $(\text{in.}H_2O)^{1/2}$

Absolute pressure of stack $(BP \pm \frac{P}{13.6})$ = P_s = 23.61 in.Hg

Stack gas velocity = V_s

$$V_s = (85.48)(\ CP\ )\left[\sqrt{\frac{(\ T_s\ )}{(\ P_s\ )(\ MS\ )}}\right]\left[\sqrt{\Delta p}\right]$$

$$V_s = (85.48)(.78)\left[\sqrt{\frac{(1711.0)}{(23.61)(28.71)}}\right]\cdot\left[.282\right]$$

= 29.87 FPS

ISOKINETIC PERCENT

Average pressure drop across orifice = ΔH = 1.23 in.H_2O

Total sampling time = T = 120 min.

Diameter of nozzle = d = .483 in.

Area of nozzle = A

$A = 54.54 \times 10^{-4}\ (d^2) = 54.54 \times 10^{-4}\ (\ \ )^2 =$ 1.272×10^{-3} sq. ft

I = percent Isokinetic

$$I = \frac{(1.667)(\ T_s\ )\left[0.00267\ (V_L\ ) + \frac{(\ V_m\ )}{(\ T_m\ )}\left(PB + \frac{(\ \Delta H\ )}{13.6}\right)\right]}{(\ T\ )(\ V_s\ )(\ P_s\ )(\ A\ )}$$

$$I = \frac{(1.667)(1711.0)\left[0.00267\ (154.1) + \frac{(85.685)}{(554.17)}\left(23.62 + \frac{(1.23)}{13.6}\right)\right]}{(120)(29.87)(23.61)(1.272 \times 10^{-3})}$$

I = 108 %

ANALYSIS REPORT

DATE 8/21/79

cc: Files
W. McDonald

TO Delaney
Trivedi

RECORD NUMBER 1-79-08-02-03

FROM
Env. Sampling & Characterization
MONSANTO RESEARCH CORPORATION
Dayton, Ohio

PROJECT NUMBER 104.1036

NOTEBOOK REFERENCE 1411 65 43

Isokinetics
Particulate On Filters

Sample I.D	Total particulate in mg.
Blank 5B-F	2.1 mg
#1 5-1-F Inlet Demister	402.1 mg
#2 5-2-F Outlet Demister	383.5 mg
#3 5-3-F Outlet Incinerator	83.2 mg
#4 5-4.-F Outlet Demister	455.3 mg

Samples were not corrected for Blank

Analyst: Flo Phillips

ANALYSIS REPORT

TO G. Rinaldi

FROM
Env. Sampling & Characterization
MONSANTO RESEARCH CORPORATION
Dayton, Ohio

DATE 9-12-79

RECORD NUMBER 1-79-08-02-03

PROJECT NUMBER 104-0136

NOTEBOOK REFERENCE 1567 414

cc: Files
W McDonal
cw

Geokinetics - Oil Shale - Particulates

Rinse - Probe tip, probe, connecting glassware

"Roto-vap" to dryness at room temp. in tared r.b. flask; desiccation 22 d. over Drierite to constant wt.

Sample	Volume, ml.	Weight, g.
Inlet - 5-1-1	645	0.8444
Incin - 5-3-1	545	0.1562
Outlet - 5-4-1	770	1.7100

Analyst: A. E. Follett

APPENDIX B

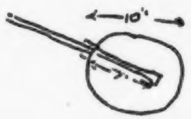
FIELD AND ANALYTICAL DATA FOR DETERMINATION OF SULFUR OXIDES AND NITROGEN OXIDES

This appendix contains the field and analytic data for determination of sulfur oxides and nitrogen oxides in gas stream samples from Geokinetics Retort No. 17. These data are: Method 6 readings, analytical results and calculations for sulfur oxide quantification, Method 7 readings, and analyses of the nitrogen oxide samples.

FIELD DATA

PLANT Geokinetics
DATE 7/20/79
SAMPLING LOCATION INLET
SAMPLE TYPE SO_2 - METHOD 6
RUN NUMBER ID - 1 - SO
OPERATOR WRF
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE
STATIC PRESSURE, (P_s)
FILTER NUMBER (s) NONE

NO TRAVERSE



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 1/4" SS 4' HEATED
NOZZLE I.D. 1/4
ASSUMED MOISTURE, % ---
SAMPLE BOX NUMBER –
METER BOX NUMBER –
METER $\Delta H_@$ –
C FACTOR
PROBE HEATER SETTING 60 on variac
HEATER BOX SETTING
REFERENCE Δp

READ AND RECORD ALL DATA EVERY ______ MINUTES LEAK RATE 0 CFM @ 10 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	~~VELOCITY HEAD (Δp_s), in. H_2O~~ SCFH	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	26 MIN				DESIRED	ACTUAL	NA	INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
	0	1615	19.602	2CFH	~~2CFH~~			78		2"		
	5	1620	19.757	2CFH				79		2"		
	10	1625	19.880	2CFH				79		2"		
	15	1630	20.011	2CFH				80		2"		
	20	1635	20.101	2CFH				81		2"		
	25	1640	20.261	2CFH				82		2"		
	END	1641 *	20.269									
	26 MIN.							79.8				
AVG.			0.667									
		*	FIRST BUBBLER FILLED.									
			PURGED	15 MIN	WITH	PEROXIDE	IMPINGER	IN	PLACE	OF	PROBE	
				1.8 CFH								
			POST	LEAK CHECK -	GOOD	@ 10" Hg						
			SILICA	GEL TURNED	BLACK							

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FIELD DATA

PLANT Geokinetics
DATE 7/21
SAMPLING LOCATION Outlet
SAMPLE TYPE SO_2 Method 6
RUN NUMBER OD-1-SO
OPERATOR WRF
AMBIENT TEMPERATURE 350F
BAROMETRIC PRESSURE 23.56
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)

PROBE LENGTH AND TYPE
NOZZLE I.D.
ASSUMED MOISTURE, %
SAMPLE BOX NUMBER
METER BOX NUMBER 1 (Method 6)
METER $\Delta H_@$ Y = 1.029 @ 2 SCFH
C FACTOR
PROBE HEATER SETTING 60 on Variac
HEATER BOX SETTING
REFERENCE Δp

SCHEMATIC OF TRAVERSE POINT LAYOUT

Precheck 0 CFH @ 10" Hg

READ AND RECORD ALL DATA EVERY ______ MINUTES

LEAK RATE 0 CFM @ 10 "Hg
Post

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY ~~HEAD~~ (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
		14 33	20.536	CFH	DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
	0	14.33	20.536	2CFH				85		2"		
	5	14.38	20.656	2CFH				85		2"		
	10	14.43	20.782	2CFH				84		2"		
	15	14.49	20.940	2CFH				82		2"		
	20	1453	21.035	2CFH				82		2"		
	25	1458	21.160	2CFH				82		2"		
	~~30~~	~~1503~~										
Power Off	{	1500	21.186	2CFH				81		2"		
	}	1501	on.									
	END.	1504	21.267									
			PURGE	15 MINS	WITH		PEROXIDE	IMPINGER		15^{10} - 15^{25}		

FIELD DATA

PLANT Geokinetics
DATE 7/22
SAMPLING LOCATION Outlet of Demister
SAMPLE TYPE Method 6 SO_2
RUN NUMBER OD-2-50
OPERATOR WRF
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)

PROBE LENGTH AND TYPE 1/4" SS Heated
NOZZLE I.D. 3/8" - Glass Wool
ASSUMED MOISTURE, % —
SAMPLE BOX NUMBER Console #1 Method 6
METER BOX NUMBER
METER $\Delta H_@$ Y = 1.029 @ 2 SCFH
C FACTOR
PROBE HEATER SETTING 40 volts
HEATER BOX SETTING
REFERENCE Δp

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

Pre check "0" CFM @ 10" Hg
LEAK RATE POST "0" CFM @ 10 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD ~~(Δp_s), in. H_2O~~ FLOW RATE	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
		1351	24,180		DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
	0	1351	24.180	2CFH				93		2		
	5	1356	24.320	2CFH				93		2		
	10	1601	24.462	2CFH				93		2		
	15	1606	24.597	2CFH				94		2		
	20	1611	24.740	2CFH				95.5		2		
	25	1616	24.931	2CFH				96.5		2		
	30	1621	25,012					98.0				
			PURGE 15 min with H_2O_2 IMPINGER					1622 Start				

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FIELD DATA

PLANT Geofermentics
DATE 7/23/79
SAMPLING LOCATION Fermentor Stack
SAMPLE TYPE SO_2 – Method 6
RUN NUMBER IS – 1 – 50
OPERATOR URF
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 23.54
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)
r = 1.029

PROBE LENGTH AND TYPE 1/4" S.S.
NOZZLE I.D. 3/8"
ASSUMED MOISTURE, %
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp

SCHEMATIC OF TRAVERSE POINT LAYOUT

Pre Test leak check 0 cfm @ 10 "Hg

READ AND RECORD ALL DATA EVERY ______ MINUTES

LEAK RATE (Post) 0 CPM @ 10 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY ~~HEAD (Δp_s), in. H_2O~~ SCFH	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
		15^{13}	26.308		DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
	0	15^{13}	26.308	2.0				78		2		
	5	15^{18}	26.452	2.0				79		2		
	10	15^{23}	26.596	2.0				79		2		
	15	15^{28}	26.740	2.0				80		2		
	20	16^{33}	26.882	2.0				82		2		
	25	15^{38}	27.020	2.0				84		2		
	30	15^{43}	27.158									
			Purged	15 min	15^{47} –							
				H_2O_2 impinger	2 cfh.							

FIELD DATA

PLANT Geokinetics
DATE 7/23/79
SAMPLING LOCATION Incinerator Stack
SAMPLE TYPE Method 6 - SO_2
RUN NUMBER IS-2-50
OPERATOR WRF
AMBIENT TEMPERATURE 100°F
BAROMETRIC PRESSURE
STATIC PRESSURE, (P_s) 23.59
FILTER NUMBER (s) —

PROBE LENGTH AND TYPE 1/4" SS Heated
NOZZLE I.D.
ASSUMED MOISTURE, %
SAMPLE BOX NUMBER
METER BOX NUMBER #1 Method 6
METER $\Delta H_@$
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp

SCHEMATIC OF TRAVERSE POINT LAYOUT

Pre Leak check '0" CFM @ 10"Hg

READ AND RECORD ALL DATA EVERY ______ MINUTES

Post LEAK RATE 0 CFM @ 10 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	~~VELOCITY HEAD (Δp_s), in. H_2O~~	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRYGAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
		1915	31.430	Flow Rate	DESIRED	ACTUAL		INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F			
	0	1915	31.430	2CFH.				100		2"	(New wire)	
	5	1920	31.569	2CFH				98		2"		
	10	1925	31.704	2CFH				97		2"	Wind @ 15 mph	
	15	1930	31.835	2CFH				93		2"		
	20	1935	31.973	2CFH				90		2"		
	25	1940	32.111	2CFH				90		2"		
	30	1945	32.248									
			Purge	15 min	H_2O_2 impingers			1948–				

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FIELD DATA

PLANT Geokinetics
DATE 7/24/79
SAMPLING LOCATION Inlet to Demister
SAMPLE TYPE Method 6 - SO_2
RUN NUMBER ID-2-SO
OPERATOR WRF
AMBIENT TEMPERATURE 100°F
BAROMETRIC PRESSURE
STATIC PRESSURE, (P_s)
FILTER NUMBER (s)

Oil thicker than earlier today. (dark colored)
Earlier it was tan colored oil and more water than oil

PROBE LENGTH AND TYPE 9/4" SS. heated
NOZZLE I.D.
ASSUMED MOISTURE, %
SAMPLE BOX NUMBER
METER BOX NUMBER
~~METER ΔH~~@ γ = 1.029
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp

SCHEMATIC OF TRAVERSE POINT LAYOUT

Preleak Rate "0" @ 11 "Hg

READ AND RECORD ALL DATA EVERY ______ MINUTES

Post LEAK RATE "0" CFM @ 11 "Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (~~Δp_s), in. H_2O~~ Flow Rate	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	30	16^{11}	35.325		DESIRED	ACTUAL		INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F			
	0	16^{11}	35.325	2				103		2"		
	5	16^{16}	35.491	2				102		2"		
	10	16^{21}	35.600	2				101		2"		
	15	16^{26}	35.735	2				101.5		2"		
	20	16^{31}	35.875	2				102		2"		
	25	16^{36}	36.015	2				102.5		2"		
END	30	16^{41}	36.150									
				Purged 15 min with H_2O_2 Impinger								

ANALYSIS REPORT	DATE 8-17-79	cc: Files W. McDonald F. Kalik CH
TO J. Delaney / G. Kindle	RECORD NUMBER 1-79-07-31-07	
FROM Env. Sampling & Characterization MONSANTO RESEARCH CORPORATION Dayton, Ohio	PROJECT NUMBER 13-022-760-51-104-0136 NOTEBOOK REFERENCE 1567 H12 - 1567 H13	

Oil Shale SO_2 - Method 6.

N Ba-perchlorate : 0.0111

Blank - Isopropanol : 0.05 ml.

Quality Assurance - 0573-5154

Experimental : 1230 mg/dscm

Given : 1248

Range : 1203-1314

Sample	Diluted vol. ml.	Aliquot, ml.	Titrant, ml.	SO_2 ~~ppm~~
ID-1-SO	100	20	0	none det
Inlet to demister				0.6 ~~0.02~~
ID-2-SO	100	40	0.65	
Inlet to demister				
OD-1-SO	100	25	0.05	none det
Outlet of demister				
OD-2-SO	100	25	0.05	"
Outlet of demister				38.4 ~~120~~
IS-1-SO	100	25	27.10	
Incinerator stack				37.8 ~~118~~
IS-2-SO	100	25	26.60	
Incinerator stack				
3% H_2O_2 7/21	-	15	0	-
B-22-SO				
3% H_2O_2 7/22	-	15	0	-
B-23-SO [received sealed & empty]				
3% H_2O_2 7/23				-
B-24-SO	-	15	0	
3% H_2O_2 7/24				

Detection limit - [illegible] mg/l

Analyst: J. E. [illegible]

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METHOD 6

SO_2 CALCULATION

Plant Geokinetics Oil Shale Date 6-30-79
Location Inlet to the Demister Run# #1 Inlet to [illegible]

Barometric Pressure Absolute (in Hg) BP = 23.64
Average Meter Temperature (°R)
Absolute (°F + 460) T_m = 539.8
Volume Through Dry Gas Meter (CF) V_m = 0.667
Volume of $Ba(ClO_4)_2$ to Titrate Sample (ml) V_t = 0.55
Volume of $Ba(ClO_4)_2$ to Titrate Blank (ml) V_b = 0.55
Normality of $Ba(ClO_4)_2$ Solution (g-eq/l) N = 0.0111
Total Volume of Solution (ml) V_s = 100
Volume of Aliquot (ml) V_a = 20
Volume of Gas at Standard Conditions (SCF) = V_g

$$V_g = 17.71 \frac{(V_m)(BP)}{(T_m)} = 17.71 \frac{(0.667)(23.64)}{(539.8)} = 0.5173$$

Concentration of SO_2 (lbs/SCF) dry basis = C

$$C = 7.05 \times 10^{-5} \frac{(V_t - V_b)(N)(V_s)}{(V_g)(V_a)} = 7.05 \times 10^{-5} \frac{(0)(.0111)(100)}{(0.5173)(20)}$$

C = 0 ~~7.5×10^{-6}~~ lbs/SCF JMR 9/24/79

Velocity of Stack Gas (Actual)(FPS) V = 33.97
% Moisture in Stack Gas M = 13.67
Area of Stack (ft^2) A = 0.545
Absolute Stack Temperature (°R) T_s = 540.4
Absolute Stack Pressure (in Hg) [illegible] P_s = [illegible].368

SO_2 Flow Rate (lbs/hr) = S

$$S = \frac{6.377 \times 10^{+4}(1-(M \times 10^{-2}))(V)(A)(P_s)(C)}{(T_s)}$$

$$S = \frac{6.377 \times 10^{4} (\quad)(\quad)(\quad)(\quad)(\quad)}{(\quad)}$$

S = 0 (lbs/hr)

JMR 9/24/79

METHOD 6

SO_2 CALCULATION

Plant [illegible] Date 8-31-79

Location Outlet of [illegible] Run# #1 -0-0-5

Barometric Pressure Absolute (in Hg) BP = 23.56

Average Meter Temperature (°R)

Absolute (°F + 460) 83 T_m = 543.0

Volume Through Dry Gas Meter (CF) V_m = 0.731

Volume of $Ba(ClO_4)_2$ to Titrate Sample (ml) V_t = 0.05

Volume of $Ba(ClO_4)_2$ to Titrate Blank (ml) V_b = 0.05

Normality of $Ba(ClO_4)_2$ Solution (g-eq/l) N = 0.0111

Total Volume of Solution (ml) V_s = 100

Volume of Aliquot (ml) V_a = 25

Volume of Gas at Standard Conditions (SCF) = V_g

$$V_g = 17.71 \frac{(V_m)(BP)}{(T_m)} = 17.71 \frac{(0.731)(23.56)}{(543.0)} = 0.5617$$

Concentration of SO_2 (lbs/SCF) dry basis = C

$$C = 7.05 \times 10^{-5} \frac{(V_t - V_b)(N)(V_s)}{(V_g)(V_a)} = 7.05 \times 10^{-5} \frac{(0)(.0111)(100)}{(0.5617)(25)}$$

C = 0 ~~5.6 x 10-6~~ lbs/SCF 9/24/79

Velocity of Stack Gas (Actual)(FPS) V = 27.87

% Moisture in Stack Gas M = 14.1

Area of Stack (ft^2) A = 0.545

Absolute Stack Temperature (°R) T_s = 580.3

Absolute Stack Pressure (in Hg) P_s = -0.0029

SO_2 Flow Rate (lbs/hr) = S

$$S = \frac{6.377 \times 10^{+4}(1-(M\times10^{-2}))(V)(A)(P_s)(C)}{(T_s)}$$

$$S = \frac{6.377 \times 10^{4}(\quad)(\quad)(\quad)(\quad)(\quad)}{(\quad)}$$

S = 0 (lbs/hr)

DMR
9/28/79

METHOD 6

SO_2 CALCULATION

Plant [illegible] Date 8-31-79

Location Outlet of [illegible] Run# C.D-2-SO

Barometric Pressure Absolute (in Hg) BP = 23.60

Average Meter Temperature (°R)

Absolute (°F + 460) 94.7 T_m = 554.7

Volume Through Dry Gas Meter (CF) V_m = 0.832

Volume of $Ba(ClO_4)_2$ to Titrate Sample (ml) V_t = 0.65

Volume of $Ba(ClO_4)_2$ to Titrate Blank (ml) V_b = 0.65

Normality of $Ba(ClO_4)_2$ Solution (g-eq/l) N = 0.0111

Total Volume of Solution (ml) V_s = 100

Volume of Aliquot (ml) V_a = 25

Volume of Gas at Standard Conditions (SCF) = V_g

$$V_g = 17.71\,\frac{(V_m)(BP)}{(T_m)} = 17.71\,\frac{(0.832)(23.60)}{(554.7)} = 0.6269$$

Concentration of SO_2 (lbs/SCF) dry basis = C

$$C = 7.05 \times 10^{-5}\,\frac{(V_t - V_b)(N)(V_s)}{(V_g)(V_a)} = 7.05 \times 10^{-5}\,\frac{(0)(.0111)(100)}{(0.6269)(25)}$$

C = 0 ~~4.99 x 10^-6~~ lbs/SCF

DMK
9/24/79

Velocity of Stack Gas (Actual)(FPS) V = 27.87

% Moisture in Stack Gas M = 14.1

Area of Stack (ft^2) A = 0.545

Absolute Stack Temperature (°R) T_s = 580.3

Absolute Stack Pressure (in Hg) [illegible] P_s = -0.0029

SO_2 Flow Rate (lbs/hr) = S

$$S = \frac{6.377 \times 10^{+4}(1-(M \times 10^{-2}))(V)(A)(P_s)(C)}{(T_s)}$$

$$S = \frac{6.377 \times 10^{4}\,(0.859)(27.87)(0.545)(0.0029)(0.00000499)}{(580.3)}$$

S = ~~0.000132~~ 0 (lbs/hr)

DMK
9/24/79

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METHOD 6

SO_2 CALCULATION

Plant GeoKinetics Date 7-31-79

Location Incinerator Stack Run# IS-1-SO

Barometric Pressure Absolute (in Hg) BP = 23.54

Average Meter Temperature (°R)

Absolute (°F + 460) 80.3 T_m = 540.3

Volume Through Dry Gas Meter (CF) V_m = 0.850

Volume of $Ba(ClO_4)_2$ to Titrate Sample (ml) V_t = 38.4

Volume of $Ba(ClO_4)_2$ to Titrate Blank (ml) V_b = 0.05

Normality of $Ba(ClO_4)_2$ Solution (g-eq/l) N = 0.0111

Total Volume of Solution (ml) V_s = 100

Volume of Aliquot (ml) V_a = 25

Volume of Gas at Standard Conditions (SCF) = V_g

$$V_g = 17.71 \frac{(V_m)(BP)}{(T_m)} = 17.71 \frac{(0.850)(23.54)}{(540.3)} = 0.6559$$

Concentration of SO_2 (lbs/SCF) dry basis = C

$$C = 7.05 \times 10^{-5} \frac{(V_t - V_b)(N)(V_s)}{(V_g)(V_a)} = 7.05 \times 10^{-5} \frac{(38.35)(0.0111)(100)}{(0.6559)(25)}$$

C = 1.83×10^{-4} lbs/SCF

Velocity of Stack Gas (Actual)(FPS) V = 29.59

% Moisture in Stack Gas M = 13.0

Area of Stack (ft^2) A = 4.37

Absolute Stack Temperature (°R) T_s = 1163.5

Absolute Stack Pressure (in Hg) P_s = −0.0059

SO_2 Flow Rate (lbs/hr) = S

$$S = \frac{6.377 \times 10^{+4}(1-(M \times 10^{-2}))(V)(A)(P_s)(C)}{(T_s)}$$

$$S = \frac{6.377 \times 10^{4}\ (0.98)(29.59)(\text{[illegible]})(.0059)(0.000183)}{(1163.5)}$$

S = 0.0235 (lbs/hr)

METHOD 6

SO_2 CALCULATION

Plant Geokinetics Date 8-31-79

Location Incinerator Stack Run# IS-2-50

Barometric Pressure Absolute (in Hg) BP = 23.54

Average Meter Temperature (°R)

Absolute (°F + 460) 94.7 T_m = 554.6

Volume Through Dry Gas Meter (CF) V_m = 0.818

Volume of $Ba(ClO_4)_2$ to Titrate Sample (ml) V_t = 26.60

Volume of $Ba(ClO_4)_2$ to Titrate Blank (ml) V_b = 0.05

Normality of $Ba(ClO_4)_2$ Solution (g-eq/l) N = 0.0111

Total Volume of Solution (ml) V_s = 100

Volume of Aliquot (ml) V_a = 25

Volume of Gas at Standard Conditions (SCF) = V_g

$$V_g = 17.71 \frac{(V_m)(BP)}{(T_m)} = 17.71 \frac{(0.818)(23.54)}{(554.6)} = 0.6149$$

Concentration of SO_2 (lbs/SCF) dry basis = C

$$C = 7.05 \times 10^{-5} \frac{(V_t - V_b)(N)(V_s)}{(V_g)(V_a)} = 7.05 \times 10^{-5} \frac{(26.55)(0.0111)(100)}{(0.6149)(25)}$$

C = 1.35×10^{-4} lbs/SCF

Velocity of Stack Gas (Actual)(FPS) V = 29.88

% Moisture in Stack Gas M = 12.0

Area of Stack (ft^2) A = 4.39

Absolute Stack Temperature (°R) T_s = 1663.5

Absolute Stack Pressure (in Hg) Pst -.59 P_s = -0.0059

SO_2 Flow Rate (lbs/hr) = S

$$S = \frac{6.377 \times 10^{+4}(1-(M \times 10^{-2}))(V)(A)(P_s)(C)}{(T_s)}$$

$$S = \frac{6.377 \times 10^{4} (.88)(29.88)(4.39)(.0059)(0.000135)}{(1663.5)}$$

S = 0.00248 (lbs/hr)

METHOD 6

SO_2 CALCULATION

Plant [illegible] Date 8-31-79

Location Inlet to the [illegible] Run# # 2

Barometric Pressure Absolute (in Hg) BP = 23.56

Average Meter Temperature (°R)

Absolute (°F + 460) [illegible] T_m = 562.0

Volume Through Dry Gas Meter (CF) V_m = 0.825

Volume of $Ba(ClO_4)_2$ to Titrate Sample (ml) V_t = 0.65

Volume of $Ba(ClO_4)_2$ to Titrate Blank (ml) V_b = 0.05

Normality of $Ba(ClO_4)_2$ Solution (g-eq/l) N = 0.0111

Total Volume of Solution (ml) V_s = 100

Volume of Aliquot (ml) V_a = 40

Volume of Gas at Standard Conditions (SCF) = V_g

$$V_g = 17.71 \frac{(V_m)(BP)}{(T_m)} = 17.71 \frac{(0.825)(23.56)}{(562.0)} = 0.6125$$

Concentration of SO_2 (lbs/SCF) dry basis = C

$$C = 7.05 \times 10^{-5} \frac{(V_t - V_b)(N)(V_s)}{(V_g)(V_a)} = 7.05 \times 10^{-5} \frac{(0.60)(0.0111)(100)}{(0.6125)(40)}$$

C = 1.91×10^{-6} lbs/SCF

Velocity of Stack Gas (Actual)(FPS) V = 33.97

% Moisture in Stack Gas M = 12.07

Area of Stack (ft^2) A = 0.545

Absolute Stack Temperature (°R) T_s = 590.4

Absolute Stack Pressure (in Hg) [illegible] P_s = +.365

SO_2 Flow Rate (lbs/hr) = S

$$S = \frac{6.377 \times 10^{+4}(1-(M\times10^{-2}))(V)(A)(P_s)(C)}{(T_s)}$$

$$S = \frac{6.377 \times 10^4 (0.8793)(33.97)(0.545)(\overset{23.614}{.365})(0.00000191)}{(590.4)}$$

S = 0.00788 (lbs/hr)

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SOURCE SAMPLING PROCEDURE – EPA METHOD 7 – NOx

Company GEOKINETICS

Sample Point SEE (ABS - Side)

Date 7-22-79

Project Oil Shale 13-022-760.43101.0134

Analyst W McDonald

Sample			Flask No.	Initial			Clean Up Analysis		Final			ABS @ 420	TOTAL Dil. ml	FLASK Vol.-Ml ml	NOx Conc. lb/scf	NOx Conc. ppm
Day	Time	No.		Bar. Press. in Hg	Flask Vacuum in Hg	Temp. °F	Day	Time	Bar. Press. in Hg	Flask Vacuum in Hg	Temp. °F					
7/22	1120	1	3/3	23.60	22.30	81°	7/23	1530	23.56	0.4	93°	Incinerator outlet		2088.5		
7/22	1124	2	7/7	23.60	22.10	81°	7/23	1545	23.56	1.2	93°	Incinerator outlet		2042.2		
7/22	1135	3	16/16	23.60	22.10	82°	7/23	1615	23.56	1.4	93°	Inlet to Demister		2038.8		
7/22	1137	4	15/15	23.60	22.10	82°	7/23	1620	23.56	0.7	93°	Inlet to Demister		2099.8		
7/22	1140	5	50/50	23.60	22.10	82°	7/23	1645	23.56	0.4	93°	outlet of Demister		2030.0		
7/22	1142	6	2/2	23.60	22.10	82°	7/23	1655	23.56	0.6	93°	outlet of Demister		2054.8		

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ANALYSIS REPORT	**DATE** 8-3-79	**cc: Files** F. Kwik CAS
TO J. Delaney	**RECORD NUMBER** 1-79-07-31-05	
FROM Env. Sampling & Characterization MONSANTO RESEARCH CORPORATION Dayton, Ohio	**PROJECT NUMBER** 13-022-760·51-101·0134 **NOTEBOOK REFERENCE** 1567409-10	

Oil Shale - NO_x

Sample	Absorbance	NO_x, Total µg
H_2O Blank - Lab	0.003	
Absorber Sol. Lab	0.008	
100 µg Standard	0.148	
200 µg "	0.285	
400 µg "	0.594	
Qual. Assur. - 1177-1231	0.313	424
		Given 421
		Range 394-448
ID-1-NO Inlet to Demister 16/16	0.005	1.9
ID-2-NO Inlet to Demister 15/15	0.016	9.4
OD-1-NO Outlet of Demister 2/2	0.010	5.3
OD-2-NO Outlet of Demister 50/50	0.010	5.3
IS-1-NO Incinerator Outlet 3/3	0.460	312
IS-2-NO Incinerator Outlet 7/7	0.628	427
Absorber Sol. - Field blank	0.001	-0.8

Analyst: A. E. Hollett

APPENDIX C

FIELD AND ANALYTICAL DATA FOR DETERMINATION OF HYDROCARBONS

This appendix contains the field and analytical data for determination of hydrocarbons in gas stream samples from Geokinetics Retort No. 17. The information includes: analyses of bag samples for total hydrocarbons and C_1 to C_6 hydrocarbon fractions, a summary of the C_1-C_6 fraction data, field data sheets for sampling with porous polymer packed tubes, analyses of both bag and tube samples for specific hydrocarbons, and a summary of the GC/MS analyses, with a list of the corresponding detection limits.

GEOKINETICS
OIL SHALE

18-022-260.93.104.0134

TOTAL Hydro Carbons

①

Sample & Time	Range	Attenuation	Pk Ht mm	PPm 1,060	PPm 10,500	AVG
7-19-79						
Methane std 1,060	10^2	8	49			
10,500	10^2	64	60.5			
10,500	10^2	128	30			
Retort #17 G-1	10^2	16	51	2574.3	2231.3	2402.8
Retort #17 Product well P-1	10^2	32	39.3	8336.5	8384.3	8360.4
Retort #17 G-2	10^2	4	33.3	353.4	361.2	357.3
Product well P-1	10^2	32	42	3565.7	3644.6	3605.2
7-19-79						
Methane 1060	10^2	8	51			
10,500	10^2	64	60.6			
10,500	10^2	128	30			
Fugitive G-3 7-19-79	10^2	64	70	11,412.6	12,120.7	11,776.2
Methane 10,500	10^2	64	60.5			
Fugitive G-4 7-19-79	10^2	64	54.6	8910.7	9476.0	9191.7
Methane std 1060	10^2	64	6			
Fugitive G-5 7-19-79	10^2	64	73.6	12006.9	12773.6	12390.2
Inlet to Demister 12:32 7-19-79	10^2	128	69.3	22610.8	24054.6	23332.7
Fugitive G-6	10^2	32	57.3	4673.9	4964.1	4819.0
10,500 methane	10^2	64	53			
Inlet to Demister 3:10 PM 7-19-79	10^2	128	60.5	19,739.6	21000.0	20,369.8
Fugitive G-7 7-19-79	10^2	2	55.4	282.4	300.5	291.4
Methane 110 PPm 7-20-79	10^2	2	26			
Methane 10,500 7-20-79	10^2	64	66			
Methane 10,500	10^2	128	32			
Fugitive G-8 7-20-79	10^2	4	48.5	494.5	525.2	509.9
Methane 110	10^2	4	12			
	10^2	1	48			
Fugitive G-8 7-20-79	10^2	8	24	489.4	520.7	505.0
	10^2	4	48.5	494.5	482.2	488.4
1060 PPm	10^2	4	89			
110 PPm	10^2	4	12	1060.0	10,500	AVG
110 PPm	10^2	1	48			
Fugitive G-8 10:00 am 7-20-79	10^2	32	83.3	3172.8	2731.6	2952.2
Outlet Sample #1 7-20-79 10:08 AM	10^2	128	71.7	27,326.6	23526.6	25426.6
G-10 Fugitive	10^2	64	82.3	6155.2	5299.2	5727.2
G-11 Fugitive	10^2	64	87.5	16674.2	14355.5	15514.8
Fugitive B-1	10^2	2	15	89.3	76.9	83.10

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[illegible]
Oil Stack

18-022-20.79, 104.0181

Total HydroCarbons

Sample & Time	Range	[illegible]	Pk ht mm	ppm 1010	ppm 10,500	Avg ppm
7-20-79 outlet Run 2 7-20-79 8:06	10^2	128	30	25,990.0	24,286.9	25,138.5
Methane 10,500 7-20-79 10,500	10^2 10^2	128 64	29 61			
Methane 1010 7-21-79	10^2 10^2	8 8	48 48			
Methane 10,500	10^2	64	66			
Methane 110 ppm	10^2	2	86			
Furnace 6-12 7-21-79	10^2	64	52	9,186.7	8672.7	8929.7
Incinerator Stack 7-21-79 10:55 AM	10^2	32	49	4323.3	3897.7	4113.0
Outlet Stack 12:40 7-21-79 1:00	10^2	128	74.8	25,369.3	22,895.5	24,132.4
Methane 10,500 10,500	10^2 10^2	128 64	28 57			
Furnace 6-13	10^2 10^2	64 32	24 56	4240.0 4946.7	4421.1 5157.9	4330.6 5052.3
Furnace 6-14	10^2	32	68.5	6050.8	6309.2	6180.0
Incinerator outlet Run #2 5:00 pm 7-21-79	10^2	4	23.3	257.3	268.3	262.8
Methane 110	10^2	2	24			
Furnace 6-15 7-21-79 9:20 pm	10^2	8	62.5	1380.2	1439.1	1409.7
Furnace 6-16	10^2	8	35.5	783.9	817.4	800.7
Incinerator outlet Run #3 7-21-79	10^2	2	51	281.6	293.6	287.6
110 ppm std	10^2 10^2 10^2	4 2 1	13 26 53.5			
10,500 ppm std	10^2	64	30			
1,010 ppm std	10^2 10^2	64 8	7 59	(1090)	10,500	
Furnace 6-17 7:15 am 7-22-79	10^2	64	45.3	7179.0	7490.6	7334.8
Furnace 6-18 7-22-79	10^2	64	25.2	4072.8	4249.6	4161.2
Furnace 6-19 7-22-79	10^2	16	45.1	1992.8	2079.3	2036.1
Furnace 6-20 7-22-79	10^2	2	60.2	298.1	311.1	304.6
Methane std 110	10^2	2	27			
Furnace 6-21 Furnace 6-22	10^2 10^2	2 4	41.3 45.7	219.4 452.7	228.9 472.3	224.2 462.5
110 ppm std	10^2	4	12			
110 ppm std	10^2	2	24			
1010 Methane std	10^2	8	52.5			
1010 Methane std	10^2	16	24			
10,500 Methane std	10^2	64	60.5			

Sample & Time	Range	Attenuation	Pk. Ht. mm	1040 PPM	10,500 PPM	Ave PPM
Fugitive G-23 7-23-79	10^2	16	68.5	2713.9	2831.6	2772.8
Fugitive G-24 7-23-79	10^2	64	37.5	5942.9	6200.8	6071.8
B-2 Fugitive 7-23-79	10^2	1	0	0	0	0
Fugitive G-25	10^2	16	61.5	2436.6	2542.3	2489.5
Fugitive G-26 7-23-79	10^2	32	84.5	6695.6	6986.2	6840.9
Fugitive G-27 7-23-79	10^2	32	25.2	1996.8	2083.5	2040.1
Std 110 PPM	10^2	8	7			
110 PPM	10^2	4	13			
110 PPM	10^2	2	28			
110 PPM	10^2	1	55.5			
Std 1040 PPM	10^2	32	15			
1040 PPM	10^2	16	31			
1040 PPM	10^2	8	61.5			
Std 10,500 PPM	10^2	64	72			
	10^2	128	35			
	10^2	256	15			
				1040	10,500	
Fugitive T-2 7-24-79	10^2	32	56.5	3618.9	3961.0	3790.0
Fugitive T-3 7-24-79	10^2	32	40	2705.7	2916.7	2811.2
Fugitive T-4 7-24-79	10^2	32	76.5	5174.6	5578.1	5376.4
Fugitive T-5 7-24-79	10^2	32	55.6	3760.9	4054.2	3907.5
Fugitive T-6 7-24-79	10^2	32	28.4	1921.0	2070.8	1995.9

OIL SHALE GEOKINETICS

Sample & Time	Range	Attenuation	Methane Pk Ht C1 m.m.	Ethane Pk Ht C2 m.m.	Propane Pk Ht C3 m.m.	Butane Pk Ht C4 m.m.	Pentane Pk Ht C5 m.m.	Hexane Pk Ht C6 m.m.	PPm C1	PPm C2	PPm C3	PPm C4	PPm C5	PPm C6
3rd 1000 PPm C1 C6	10³	16	80	89	88	92	30	36						
3rd Percent [illegible]	10³	16	15											
Inlet Column	10³	30	91	40	18	10	4	4	9,583.7	1578.3	695.6	478.4	183.6	18.9
	10³	82	81	46	40	13	9	6	8,798.3	2051.8	816.4	611.5	246.1	17.0
[illegible] C1 C6 1000	10³	8	89	97	77	84	76	36						
[illegible] T-1	10³	16	1						10⁵	—				
P-1 Product well	10³	4	56	28	17	7	6	1	787.1	259.1	86.7	41.2	18.9	9.6
	10³	4	59	28	18	7	6	2	756.3	249.0	91.8	41.2	19.3	1.13
C1 C6 1000	10³	8	90	91	78	86	74	70						
Sample #1 Inlet to [illegible] Demister 7/19/79	10³	32	86	23	19	19	6	4	8,615.0	1832.6	775.2	364.5	309.2	18.0
			82	29	19	12	6	4	8,626.0	1912.3	776.4	364.5	309.2	18.0
C1 C6 100 PPm [illegible]	10³	32	2	2	2	2	2	2						
Inlet to Demister [illegible] Pm 7-19-79	10³	64	84	9	8	5	1	2	7,160.7	1434.2	652.8	478.4	109.1	18.0
	10³	32	61	19	15	10	2	5	7,204.0	1512.9	612.0	478.4	109.1	22.5
C1 C6 1000 PPm	10³	32	30	12	19	31	18	16						
Fraction G-9 7-19-79	10³	16	38	9	5	1	2	2	1732.9	390.6	162.0	23.5	34.5	4.50
C1 C6 1000 PPm	10³	8	89	96	72	77	64	65						
			89	97	72	77	65	65						
7-20-79 1000 PPm C1 C6	10³	64		89	39	30	26	3						
10,000 PPm C1 C6	10³	108	20	30	40	35	13	8						
Run #1 outlet 7-20-79 10:48 Am	10³	32	38	31	16	9	5	2	4801.6	1663.3	652.8	432.9	257.7	9.4
Fraction G-11 7-20-79	10³	16	87	17	12	8	4	2	3001.2	672.1	249.9	198.2	103.1	6.75
			58	16	12	6	3	8	2895.9	693.0	249.1	1411	77.3	9.0
C1 C6 100 PPm	10³	2	12	20	20	27	3	9						
Run 2 outlet [illegible] Pm Sample	10³	32	35	18	9	8	5	2	7091.0	1108.0	505.6	191.0	257.7	9.0
	10³	32		19	15	9	3	2		1301.9	875.6	432.0	154.6	9.0
	10³	64	27	10	7				7792.5	1397.0	819.9			
C1 C6 1000 PPm	10³	8	99	87	89	96	80	80						
C1 C6 1000 PPm	10³	16	51	58	81	81	63	65						
	10³	16	44	48	42	44	38	36						

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OIL SHALE GEOKINETICS

Sample & Time	[illegible]	[illegible]	Pk ar C-1	Pk ar C-2	Pk ar C-3	Pk ar C-4	Pk ar C-5	Pk ar C-6	PPm C-1	PPm C-2	PPm C-3	PPm C-4	PPm C-5	PPm C-6
C1 C6 1000 PPm [illegible]	10^{6}	8	19	29	81	96	80	80						
[illegible] smoke Run 1	10^{6}	8	69	10	8				16024	198.0	18.5			
Outlet 7-21-79 [illegible] Outlet 9-21-79 [illegible]	10^{6} 10^{6}	69 16	99 72	14 48	11 89	6 11	6 7	6 8	9990.4 8790.9	2217.6 1762.8	9584 948.5	695.1 295.7	404.1 104.1	34.0 18.6
6-19 Feeder	10^{6} 10^{6}	9 8	 97	35 17	21 21	13 8	8 8	5 3	 1257.1	336.7 336.6	102.5 101.9	87.9 67.2	19.5 21.3	2.91 2.38
[illegible] Outlet Run #2	1	16	5	10	10	3	3	6	2.90	2.12	2.02	1.46	9.34	13.5
100 PPm C1 C6	1	128	27	45	48	82	17	5						
[illegible] Outlet Run #3	1	16	8	11	10	6	14	7	3.5	2.99	2.03	1.44	9.43	15.75
Feeder 8-17	10^{3} 10^{3}	16 8	37 73	12 29	8 15	9 8	2 4	3 6	1389.4 1921.8	475.2 475.4	192.1 189.0	107.5 107.5	51.5 51.5	6.75 6.75
100 PPm C1 C6 1000 PPm C1 C6	10^{3} 10^{3} 10^{3}	8 16 8	5 29 49	8 29 58	11 43 87	9 45 98	3 87 75	3 85 72						
Feeder 6-24	10^{3} 10^{3}	8 16	 94	18 9	12 6	8 4	3 2	4 2	 1262.7	336.4 336.4	119.5 119.5	107.5 107.5	38.3 51.5	4.50 4.50
100 PPm C1 C6	10^{2}	2	16	28	82	39	3	9						
Feeder T-2 7-24-79	10^{3} 10^{3}	8 4	32 57	11 19	6 11	4 7	2 3	3 5	812.4 776.6	2178 188.1	99.3 99.6	53.8 97.0	25.3 17.3	3.38 3.81
1000 PPm C1 C6	10^{2}	8	92 42	51 51	75 76	80 81	66 66	60 61						
Feeder T-2 7-24-79	10^{3}	4	59	19	11	7	8	5	~~776.6~~	~~188.1~~	~~54.0~~	~~97.0~~	19.3	3.81

TABLE C-1. QUANTIFICATION OF C_1-C_6 HYDROCARBON FRACTIONS IN GAS STREAMS FROM GEOKINETICS RETORT NO. 17

Sample point	Date and approximate sampling time	Concentration, parts per million, by volume					
		C_1	C_2	C_3	C_4	C_5	C_6
Demister inlet	7/19/79 12:30 PM	8,600[a]	1,900	780	560	310	20
	7/19/79 3:00 PM	7,200[a]	1,500	630	470	100	20
Demister outlet	7/20/79 10:00 AM	4,000	1,700	650	420	260	9
	7/20/79 4:00 PM	7,800[a]	1,400	740	280	210	9
Incinerator outlet	7/21/79 3:30 PM	3	3	2	2	5	10
	7/21/79 4:30 PM	4	3	2	2	4	20

[a] C_1-C_6 concentrations are averages of duplicate analyses of the sample.

HYDROCARBON SAMPLING

COLLECTOR TUBE METHOD

Plant [illegible]
Location [illegible]
Barometric Pressure ______

Date 7/24/79
Test No. 1

	Clock Time		Run Time	Cylinder Pressure		Cylinder Temp.		Tube No.		Cylinder Volume	Sampling Rate
	Init.	Final		Init.	Final	Init.	Final				
	~~[illegible]~~		~~—~~	~~21.6~~		~~92~~		TE 18	XAD 1	~~0.428 ft³~~	~~2 cfh~~
#1	1626		2 min	20.2	17.8	88	89	TEN 28	XAD 9	0.428 ft³	2 cfh -
								7			
#2	1643		1 min	17.7	16.8	89	89	TE 41	XAD 15	0.429 ft³	2 cfh
#3	1656		30 sec	16.8	16.1	88	88	TE 233	XAD 10	0.428 ft³	2 cfh

#1 Breakthru flask 2 open - [illegible] - [illegible] -

#2 [illegible] 036

#3 [illegible] 037

Sample Volume at Standard Conditions

$$V_s = 17.71 \times V_c \times \left(\frac{P_f}{T_f} - \frac{P_i}{T_i}\right)$$

where:

V_s = Sample Volume, ft³
V_c = Cylinder Volume, ft³
P = Barometric Pressure - Cylinder Pressure ("Hg)
T = Temperature of cylinder + 460
(°R) (°F)

HYDROCARBON SAMPLING

COLLECTOR TUBE METHOD

Plant [illegible]
Location Outlet Canister
Barometric Pressure

Date 7/24/79
Test No. 1

	Clock Time		Run Time	Cylinder Pressure		Cylinder Temp.		Tube No.		Cylinder Volume	Sampling Rate
	Init.	Final		Init.	Final	Init.	Final				
#1	17^{32}		2 —	21.0	18.8	97	98	TE 9	XAD 7	0.428 ft^3	2 cfh.
#2	17^{45}		3 min	18.7	15.4	99	100	TE 24	XAD 5	0.428 ft^3	2 cfh
	1^{15}		1:45	15.4	14.0	100	100	TE 244	XAD 14	0.428 ft^3	2 cfh
			2:15	20.5	~~100~~	100	140				
			[illegible]		19.9						

Sample Volume at Standard Conditions

$$V_s = 17.71 \times V_c \times \left(\frac{P_f}{T_f} - \frac{P_i}{T_i}\right)$$

where:

V_s = Sample Volume
V_c = Cylinder Volume
P = Barometric Pressure - Cylinder Pressure ("Hg)
T = Temperature of cylinder + 460

#1 Breakthru [illegible] 3ppm - 3ppm background - (#01'4)

#2 Breakthrough 2 div higher than background. #036

#3 Background 657 Breakthrough about 2ppm -

HYDROCARBON SAMPLING

COLLECTOR TUBE METHOD

Plant Geokinetics

Location Incinerator Stack

Barometric Pressure ______

Date 7/24/79

Test No. ______

Clock Time		Run Time	Cylinder Pressure		Cylinder Temp.		Tube No.		Cylinder Volume	Sampling Rate
Init.	Final		Init.	Final	Init.	Final				
1520		4 min 17 sec*	22.2	18.4	82	96	TE26	XAD 8	0.421 ft^3	2 cfh
1534		2 min	18.2	16.2	92	94	TE 210	XAD 12	0.421 ft^3	2 cfh
1547		3 min	20.8	17.3	92	95	TE 16	XAD 6	0.428 ft^3	2 cfh.

* Flow dropped drastically – aborted sampling

ppm Analyzed

#1 – 1ppm – 1ppm – Backup flask

#2 – Backup [illegible] 1ppm – 1ppm background
(041)

#3 [illegible] flask 5ppm – 5ppm back
(036)

Sample Volume at Standard Conditions

$$V_s = 17.71 \times V_c \times \left(\frac{P_f}{T_f} - \frac{P_i}{T_i}\right)$$

where:

V_s = Sample Volume
V_c = Cylinder Volume
P = Barometric Pressure – Cylinder Pressure ("Hg)
T = Temperature of cylinder + 460

ANALYSIS REPORT	DATE 9-19-79	cc:Files J. Brooks F. Kulik D. Sharp L. Kasten A. Wright
TO G. RINALDI	RECORD NUMBER 1-79-08-02-05 1-79-07-31-06	
FROM **ANALYTICAL SERVICES** **MONSANTO RESEARCH CORPORATION** **Dayton, Ohio**	PROJECT NUMBER 15-022-760.59-104.0136 NOTEBOOK REFERENCE	

GC/MS Analysis of Oil Shale air samples for Organics.

The samples consisted of Gas Bags and packed Tubes. The Geokinetics gas bags were analyzed using a 6' OV-1 SS column operated at 0°C-4min then 8°C/min to 250°C. The bags were sampled by connecting them to a gas sampling valve and forcing 3 to 4 ml of gas through the valve.

The Tubes were solvent desorbed with methanol. ~~and~~ the methanol extracts were analyzed using the same OV-1 column operated at 60°C-2min then 8°C/min up to 250°C. Both samples were analyzed using the HP-5982A GC/MS System. After identification the compounds found in the tubes were quantified by the use of standards injected under the same conditions. The compounds found were not quantitated. POM's were looked for in the extracts from the Tubes but none detected.

ANALYST: A.T. Wright & Linda Kasten

ANALYSIS REPORT

TO G. RinalDi	DATE 9-19-79	cc:Files
	RECORD NUMBER	
FROM **ANALYTICAL SERVICES** MONSANTO RESEARCH CORPORATION Dayton, Ohio	PROJECT NUMBER 13-022-760.59-104.0136	
	NOTEBOOK REFERENCE	

Results

Geokinetics GAS BAGS

Compound	BG-ID-2	BG-OD-2	BG-IS-1	Blank
C_3 - C_{10} Alkane	Detected	Detected	N.D.	N.D.
C_4 - C_6 Alkene	Detected	Detected	N.D	N.D
C_1 - C_3 Cyclohexane	Detected	Detected	N.D.	N.D.
Benzene	Detected	Detected	N.D.	N.D.
Toluene	Trace	trace	N.D.	N.D.
C_2 - Benzene	Trace	Trace	N.D.	N.D

N.D. Not Detected

Sample No.	Sample Location
BG-ID-2	Inlet To demister
BG-OD-2	Outlet To demister
BG-IS-1	Incinerator Stack

Packed Tubes

Total µg/Tube

Compound	Te #25	XAD #9	Te #244	XAD #14	Te #26	XAD #8
Toluene	68	15	216	180	10	N.D.
C_2 - Benzenes	166	8	390	19	N.D.	N.D.
C_3 - Benzenes	97	N.D.	186	2	N.D.	N.D.
C_5 - C_{10} Aliphatics	480	247	926	662	N.D.	N.D
C_3 - CycloHexanes	30	140	250	154	N.D.	N.D.

Te - Tenax Packed Tube

XAD - XAD - Resin Packed Tube

Sample No.	Sample Location
Te-25 + XAD #9	Inlet - 2 min - Front + Back
Te-244 + XAD #14	Outlet - 4 min - Front + Back
Te-26 + XAD #8	Incinerator 4 min - Front + Back

Detection Limit µg/Tube

Toluene - 2 µg

C_2 - Benzene - 2 µg

C_3 - Benzene 2 µg

C_5 - C_{10} Aliphatic 5 µg

C_3 - Cyclohexane 5 µg

ANALYST: Art. Wright + Linda Kasten

TABLE C-2. MASS OF SPECIFIC HYDROCARBONS FROM GEOKINETICS GAS STREAMS COLLECTED BY PACKED TUBES

Compound(s)	Mass collected, µg					
	Demister inlet		Demister outlet		Incinerator outlet	
	Tenax	XAD	Tenax	XAD	Tenax	XAD
Toluene	68	15	216	180	10	-[a]
C_5 - C_{10} Aliphatics[b]	480	247	826	662	-	-
C_2 Benzenes	166	8	390	19	-	-
C_3 Benzenes	97	-	186	2	-	-
C_3 Cyclohexanes	30	140	250	154	-	-

[a] Blanks indicate compound(s) was(were) not detected; see Table C-3 for detection limits.

[b] This group includes straight-chain and branched alkanes, alkenes, and alkynes.

TABLE C-3. DETECTION LIMITS FOR SPECIFIC HYDROCARBONS AS MEASURED BY COLLECTOR TUBE METHOD

Compound(s)	Detection limit,[a] µg/tube
Toluene	2
C_5 - C_{10} Aliphatics	5
C_2 Benzenes	2
C_3 Benzenes	2
C_3 Cyclohexanes	5

[a] Applicable to both Tenax- and XAD-packed tubes.

APPENDIX D

FIELD AND ANALYTICAL DATA FOR DETERMINATION OF AMMONIA, ARSINE, AND HYDROGEN CYANIDE

This appendix contains field data sheets and analytical results for sampling of ammonia (NH_3), arsine (AsH_3), and hydrogen cyanide (HCN) in demister inlet and outlet gases and incinerator exhaust from Geokinetics Retort No. 17.

GENERAL DATA SHEET

TYPE RUN - NH_3

DATE: 7/19/79
RUN NO. FD-1-NH

LOCATION: Inlet
OPERATORS: WRF

Leak Check - no visible flow @ 13" Hg. Run Pressure ≈ 4" Hg vac.

	INITIAL	FINAL	
METER TEMPERATURE	90°F	90°F	
METER READING	17.653	18.502	
TIME	453 PM	523 PM	
FLOW RATE	2 CFH	2CFH	
AROMETRIC PRESSURE	23.62	23.62	

COMMENTS: 15 ml of 0.1 M H_2SO_4

Spray trap place ahead of 1st bubbler.

2nd impinger - Acid to Test paper at end of run (Gas in Stream is basic.)

Production Data

	Start (453)	Middle (509)	End (522)
1.	0.5"	0.5"	0.5"
2.	0.1"	0.1"	0.4"
3.	0.0"	0.0"	0.0"
4.	1.6"	1.5"	1.6"

Silica gel turned dark in color.

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GENERAL DATA SHEET

TYPE RUN - Ammonia

DATE: 7/22/79 RUN NO. OD-1-NH

LOCATION: OUTLET OF DEMISTER OPERATORS: WRE

	INITIAL	FINAL	
METER TEMPERATURE	88°F	90.5°F	
METER READING γ = 1.029	22.470	23.255	
TIME	9^{10}	9^{40}	
FLOW RATE	2CFH	~2CFH	
BAROMETRIC PRESSURE			
VACUUM	5" Hg	7" Hg	

COMMENTS: Leak check - Before "0" CFH @ 10" Hg.

30 ml of 0.1 M H_2SO_4 (0.2 N) IN MIDGET BUBBLES (2 ea)

9^{15} 22.615 @ 88°F (5" Hg)
9^{20} 22.755 @ 89°F (5" Hg)
9^{25} 22.894 @ 89°F (5" Hg)
9^{30} 23.005 @ 89°F (5.5" Hg)
9^{35} 23.140 @ 90°F (6" Hg)

Leak check after "0" CFH @ 10" Hg

SOLN ACIDIC AT END OF RUN.

GENERAL DATA SHEET

TYPE RUN - Ammonia

DATE: 7/23/78 RUN NO. IS-1-NH

LOCATION: Incinerator Stack OPERATORS: WRF

	INITIAL	FINAL	
METER TEMPERATURE	88°F	86°F	
METER READING	29.518	30.459	
$\gamma = 1.029$			
TIME	17^{58}	18^{08}	
FLOW RATE	2CFH	2CFH	
.AROMETRIC PRESSURE	23 54		
Vacuum	5.5	6" Hg	

COMMENTS: Leak check "0" CFM @ 10" Hg

17^{53} 30.002 87°F 6" Hg

Post leak check Good

GENERAL DATA SHEET

TYPE RUN - Ammonia

DATE: 7/24/79

RUN NO. ID-2-NH

LOCATION: Inlet to Demister

OPERATORS: WCF

	INITIAL	FINAL	
METER TEMPERATURE	80°F	85.5°F	
METER READING $\gamma = 1.029$	32.678	33.555	
TIME	10^{55}	11^{25}	
FLOW RATE	2CFH	2CFH	
.AROMETRIC PRESSURE			
Vacuum " Hg	5" Hg	5" Hg	

COMMENTS: Leak check @ 10" Hg – no flow –

32.832@	11^{00}	80°F	5" Hg
32.980@	11^{05}	81°F	6" Hg
33.130 @	11^{10}	82°F	5" Hg
33.2269@	11^{15}	83°F	5" Hg
33.411 @	11^{20}	84°F	5" Hg

Post leak check @ 10" Hg – no flow –

ANALYSIS REPORT

TO: G. Rinaldi

FROM
ANALYTICAL SERVICES
MONSANTO RESEARCH CORPORATION
Dayton, Ohio

DATE 9-19-79

RECORD NUMBER 1-79-08-01-05

PROJECT NUMBER 104-0136

NOTEBOOK REFERENCE 1567 425 1567 432

cc: Files

Title: Oil Shale - Ammonia

Method: Specific Ion electrode - Ammonia - Method 350.3

Sample	Total vol. ml.	Total NH_3-N, mg
OD-1-NH Outlet of Demister	100	21
ID-2-NH Inlet of Demister	100	28
IS-1-NH Incinerator stack	100	none detected
B-NH-1 Blank - H_2SO_4		none detected.

ANALYST: G. [illegible]

GENERAL DATA SHEET

TYPE RUN - Arsine

DATE: 9/20/79

RUN NO. ID-1-AR

LOCATION: Inlet

OPERATORS: WRF

	INITIAL	FINAL	AVG
METER TEMPERATURE	79	85	82
METER READING	18.594	19.436	0.842
TIME	10^{23}	10^{53}	30 MIN
FLOW RATE (on Rotometer)	2 CFH	2 CFH	2 CFH
BAROMETRIC PRESSURE			

Leak checked at 14" Hg.

COMMENTS: Train — 1 PbAc Cotton wool

1 - Bubbler 15 ml
1 - " "
1 - Impinger 15 ml
} Total 45 ml 5% Sodium hypochlorite

1 - Glass wool - drying tube
1 - Silica gel - " "

Cotton wool dark after 10 minutes,

4" Hg vacuum.

15 ml in bubbler - fills impinger with bubbles during run.

Meter Temp - 82°F @ 10^{37}

Silica gel - remained blue colored.

PbAc cotton wool - mostly black.

GENERAL DATA SHEET

TYPE RUN - Arsine

DATE: 7/22/79 RUN NO. OD-1-AE

LOCATION: Outlet of Demister OPERATORS: WRF

	INITIAL	FINAL	
METER TEMPERATURE	82	87°F	
METER READING r = 1.029	23.264	24.178	
TIME	14^{12} off 14^{17}-14^{22}	14^{47}	
FLOW RATE	2 CFH	2 CFH.	
.AROMETRIC PRESSURE			
Vacuum.	5" Hg.	10" Hg.	

COMMENTS: Filter - PbAc IMP. - Bubbler (15 ml) - Bubbler (15 ml) - Impinger (15 ml) - Glasswool, - Silica gel

14^{17}-14^{22} Power Off - Filter came apart - Replaced and continued sampling.

Valid sample - ?

14^{22} 23.462 @ 82°F 5.5" Hg.

14^{27} 23.613 @ 83°F 5.5" Hg

14^{32} 23.738 @ 84°F 8.0" Hg.

14^{37} 23.877 @ 85°F 9.0" Hg

14^{42} 24.027 @ 86°F 9.5" Hg

GENERAL DATA SHEET

TYPE RUN - Arsine

DATE: 7/22/79 RUN NO. OD-2-AC

LOCATION: Outlet of demister OPERATORS: URF

	INITIAL	FINAL	
METER TEMPERATURE	~~25.308~~ 104°F	104.5	
METER READING	25.308	26.300	
TIME	17^{18}	17^{48}	
FLOW RATE	2 CFH	2 CFH	
BAROMETRIC PRESSURE			
Vacuum	4.5" Hg.	4.5" Hg.	

Filter 654-31

COMMENTS: Pre leak check "0" cfm @ 12" Hg.
Filter - PbAc cotton wool, bubbler 15 ml 5% HgCl$_2$, bubbler 15 ml 5% [illegible]
Impinger 15 ml - Glass wool, silica gel.
17^{38} 25.961 106°F 4.5" Hg
Post leak check "0" cf @ 12" Hg.

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GENERAL DATA SHEET

TYPE RUN - Arsine

DATE: 7/23/79

RUN NO. IS-1-AR

LOCATION: Incinerator

OPERATORS: aRF

	INITIAL	FINAL	
METER TEMPERATURE	98°F		
METER READING	28.469	No Good	
TIME	16^{55}		
FLOW RATE	2CFH		
BAROMETRIC PRESSURE	23.54		
Vacuum "Hg	6.5"		

COMMENTS: Leak check "0" cfm at 10"Hg.

17^{00} 25.991 @ 90°F 6.5" Hg

Run Void - Filter came apart -

GENERAL DATA SHEET

TYPE RUN - Arsine

DATE: 7/23/79

RUN NO. IS-2-AS

LOCATION: Incinerator Stack

OPERATORS: WRF

	INITIAL	FINAL	
METER TEMPERATURE	84°F	94°F	
METER READING	30.479	31.414 ~~31.996~~	
TIME	18^{24}	18^{54}	
FLOW RATE	2 CFH	2 CFH	
.AROMETRIC PRESSURE	23.54		
Vacuum	6.5" Hg	6.5" Hg	

COMMENTS:

18^{42} 31.028 90°F 6.5" Hg

Filter - Cotton Wool - $\underbrace{\text{Impinger - Bubbler - Bubbler}}_{\text{15 ml each}}$ - Glass Wool - Silica gel

Leak check @ 10" Hg Good

Post leak check @ 10" Hg "

GENERAL DATA SHEET

TYPE RUN - Arsine

DATE: 7/24/79

RUN NO. ID-2-AR

LOCATION: Inlet to Demister (Retort Gas)

OPERATORS: WRF

	INITIAL	FINAL	
METER TEMPERATURE	88°F	93°F	
METER READING γ = 1.029	33.564	34.439	
TIME	11^{44}	12^{14}	
FLOW RATE	2CFH	2 CFH	
.AROMETRIC PRESSURE			
Vacuum	6.5" Hg	4.0	

COMMENTS: Pre leak check @ 10" Hg – No visible flow

11^{49} – 33.705 @ 88°F 7" Hg

11^{54} – 33.850 @ 89°F 7.5" Hg

11^{59} – 34.004 @ 90°F 7.5" Hg

12^{04} – 34.153 @ 91°F 7.5" Hg

12^{09} 34.300 @ 92°F 8.0" Hg

Post leak check @ 10" Hg – no visible flow

GENERAL DATA SHEET

TYPE RUN - HCN

DATE: 7/19/79

RUN NO. ID-1-CN

LOCATION: INLET

OPERATORS: WRF

Leak check - no visible flow at 14" Hg vacuum.

	INITIAL	FINAL	
METER TEMPERATURE	100°F	102°F	
METER READING	16-606	16.772	
TIME	2^{10} PM	217	
FLOW RATE	2 CFH	2 CFH	
AROMETRIC PRESSURE	23.62	23.62	

COMMENTS: 2 KOH impingers (bubblers) 15 ml of 0.1 M KOH
1 - Glass wool
1 - Silica Gel

Shut down after 7 minutes when 1st impinger filled to overflowing

No filter used at this location.

GENERAL DATA SHEET

TYPE RUN - HCN

DATE: 7/19/79

RUN NO. ID-2-CN

LOCATION: Inlet

OPERATORS: WRE

	INITIAL	FINAL	
METER TEMPERATURE	108°F	106°F	
METER READING	16.807	17.640	
TIME	2^{56}	3^{26}	
FLOW RATE	2CFH	2CFH	
BAROMETRIC PRESSURE	23.62	23.62	

COMMENTS: Meter Factor=1.029
Bubbler Impinger added before 1st KOH impinger for spray trap
Silica gel turned dark color

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GENERAL DATA SHEET

TYPE RUN - HCN

DATE: 7/21/79

RUN NO. 1 (OD-1-CN)

LOCATION: OUTLET

OPERATORS: WRF

	INITIAL	16MIN	FINAL	
METER TEMPERATURE	84	84	86	
METER READING	21.705	22.120	22.461	
TIME	17^{00}	17^{16}	17^{30}	
FLOW RATE (ROTAMETER)	2CFH	2CHF	2CHF	
BAROMETRIC PRESSURE				
VACUUM	5" Hg	5" Hg	5" Hg	

COMMENTS: LEAK CHECK "0" CFH @ 10" Hg.
POST LEAK CHECK "0" CFH @ 10" Hg.

GENERAL DATA SHEET

TYPE RUN - HCN

DATE: 7/23/79

RUN NO. IS-1-CN

LOCATION: Incinerator

OPERATORS: WRF

	INITIAL	FINAL	
METER TEMPERATURE	88°F	92°F	
METER READING $\gamma = 1.029$	27.533	28.454	
TIME	16^{10}	16^{40}	
FLOW RATE	2CFH	2CFH	
AROMETRIC PRESSURE	23.59		
Meter Vacuum	5.5" Hg	5.5	

Pre leak check "0" @ 10" Hg
Post leak check "0" @ 10" Hg } Filter + Impinger Train

COMMENTS:

16^{25} 27.998 @ 92°F 2CFH 5.5" Hg

GENERAL DATA SHEET

TYPE RUN - HCN

DATE: 7/24/79

RUN NO. ID-3-CN

LOCATION: Inlet to demister

OPERATORS: WRF

	INITIAL	FINAL	
METER TEMPERATURE	97.5	100°F	
METER READING r = 1.029	34.445	35.314	
TIME	1443	1513	
FLOW RATE	2CFH	2CFH	
BAROMETRIC PRESSURE			
Meter Vacuum "Hg	4" Hg.	4.5	

COMMENTS: Pre leak check Good @ 10" Hg – no visible flow

1448	34.589	@ 97°F	4.5" Hg
1453	34.736	@ 98°F	4.5" Hg
1459	34.907	@ 99°F	4.5" Hg
1503	35.022	@ 100°F	4.5" Hg
1508	35.170	@ 100°F	4.5" Hg

Post leak check @ 10" Hg no visible flow

ANALYSIS REPORT	DATE 8/15/79	cc: Files ~~Delaney~~ S. Rinaldi
TO J. Delaney / S. Rinaldi	RECORD NUMBER 1-79-08-02-01	
FROM Env. Sampling & Characterization MONSANTO RESEARCH CORPORATION Dayton, Ohio	PROJECT NUMBER 1-022-760.51-104.0136	CK
	NOTEBOOK REFERENCE 1566169	

Title: Oil Shale Cyanide Sample Results

Method: Auto Analyzer

Sample	volume of sample* ml	Cyanide Concentration, mg/l	CN⁻ mg/samp
IS-1-CN	~79 ml	0.008	0.0006
ID-3-CN	79 ml	1.05	0.083
OD-1-CN	52 ml	1.83	0.095

* IS-1-CN volume was estimated to be ~79 ml by using the ID-3-CN + OD-CN sample JF

ID-3-CN and OD-1-CN were measured by volume mark on plastic sample container; therefore volume would approximately ± 2 ml JAF

Analyst: Michael [illegible]

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APPENDIX E

ANALYTICAL DATA FOR DETERMINATION OF TRACE ELEMENTS IN GAS AND WATER SAMPLES

This appendix contains all the results of laboratory analyses of gas and water samples from Geokinetics Retort No. 17 for trace elements. The data generated by inductively coupled argon plasma (ICAP) optical emission spectroscopy are listed first, ending with a comparison of true and measured concentrations in quality control samples analyzed by that technique. Raw data from atomic absorption analyses follows. The appendix ends with a table of detection limits and lowest quantitatively determinable concentrations for trace element analyses and two tables listing sample masses collected from filter and impinger samples of Geokinetics gas streams.

ANALYSIS REPORT	DATE 9 Nov 1979	cc:Files
TO G. Rinaldi	RECORD NUMBER 1·79·08·02·03	
FROM **ANALYTICAL SERVICES** **MONSANTO RESEARCH CORPORATION** **Dayton, Ohio**	PROJECT NUMBER 13·022·760·51·104·0134 NOTEBOOK REFERENCE DATA ATTACHED	

Title: Oil SHALE/GEOKINETICS

Method: ICMP

ICMP DATA FOR THE SAMPLES SUBMITTED ARE ATTACHED. DATA GIVEN AS micrograms of Analyte PER milliliter of SAMPLE. TO CONVERT to total milligrams PER IMPINGER or Filter, multiply ICMP DATA BY Final or Dilution VOLUME (SHEET ATTACHED).

ICMP (milligrams/liter) x $\overset{\text{Dilution}}{\text{volume}}$ (liters) = Total milligrams

ANALYST:

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                           10-24-1979

                      ---ANALYSIS REPORT---
      INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING

SAMPLE IDENTITY        03-106
DILUTION FACTOR =        1.00
SAMPLE WEIGHT   =     1.00000

18.AG =      0.028          9. CU =      0.019         1A. SB =      0.024
1.AL =       0.574         10. FE =      0.071         17. SI =      0.030
2.BA =       0.041         11. MG =      0.835         21. SN =      0.015
3.BE =  <    0.000         12. MN =      0.004         20. SR =      0.006
4.B  =       0.545         13. MO =      0.014         22. TI =      0.007
6.CA =       3.288         19 NA =      41.954         23. V  =      0.029
5.CD =       0.006         14. NI =      0.126         24. ZN =      0.037
8.CO =       0.004         16. PB =      0.060         1b. K  =      1.377
7.CR =       0.010         15. P  =      0.134

**********************************************************************

CONCENTRATIONS IN PARTS PER MILLION

     EXPLANATION OF SPECIAL SYMBOLS -----

          < --- BELOW DETECTION LIMIT
```

141507-8-B Filter

5-B-F

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     INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING

SAMPLE IDENTITY      03-107
DILUTION FACTOR =      1.00
SAMPLE WEIGHT   =   1.00000

 AG =        0.011              CU =        0.020              SB =        0.015
 AL =        0.443              FE =        0.152              SI =        0.503
 BA =        0.012              MG =        0.798              SN =        0.189
 BE = <      0.000              MN =        0.005              SR =        0.005
 B  =        1.004              MO =        0.020              TI =        0.006
 CA =        3.419              NA =       43.134              V  =        0.018
 CD =        0.008              NI =        0.110              ZN =        0.031
 CO =        0.007              PB =        0.137              K  =        1.787
 CR =        0.008              P  =        0.084

*********************************************************************

CONCENTRATIONS IN PARTS PER MILLION

     EXPLANATION OF SPECIAL SYMBOLS -----

          < --- BELOW DETECTION LIMIT
```

1415C78-I

Filter
5-1-F

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                       10-24-1979

                    ---ANALYSIS REPORT---
    INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING
                                            Filter 5-3-F
SAMPLE IDENTITY       03-108
DILUTION FACTOR =       1.00*
SAMPLE WEIGHT   =     1.00000*           1415078-2

 AG =       0.002             CU =     0.016            SB =     0.010
 AL =       0.339             FE =     0.071            SI =     0.522
 BA =       0.005             MG =     0.500            SN =     0.121
 BE = <     0.000             MN =     0.002            SR =     0.004
 B  =       0.188             MO =     0.005            TI =     0.008
 CA =       2.322             NA =    40.434            V  =     0.011
 CD =       0.004             NI =     0.063            ZN =     0.019
 CO =       0.006             PB =     0.036            K  =     1.011
 CR =       0.005             P  =     0.043

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

CONCENTRATIONS IN PARTS PER MILLION

     EXPLANATION OF SPECIAL SYMBOLS -----

          < --- BELOW DETECTION LIMIT
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ICP HGP
1212783

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    INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING

SAMPLE IDENTITY       03-100
DILUTION FACTOR =       1.00
SAMPLE WEIGHT   =    1.00000

 AG =       7.003             CU =      0.017             SB =      0.015
 AL =       0.880             FE =      0.484             SI =      0.088
 BA =       0.119             MG =      0.849             SN =      0.476
 BE = <     0.000             MN =      0.012             SR =      0.021
 B  =       4.243             MO =      0.002             TI =      0.015
 CA =       4.693             NA =      2.865             V  =      0.022
 CD =       0.002             NI =      0.007             ZN =      0.227
 CO =       0.003             PB =      0.016             K  =      0.557
 CR =       0.014             P  =      0.109
****************************************************************************

CONCENTRATIONS IN PARTS PER MILLION

    EXPLANATION OF SPECIAL SYMBOLS -----

        < --- BELOW DETECTION LIMIT
```

MRC ICP #

MRC AA
GEO 1

Impinger
5-I-2

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10-24-1979

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INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING

GEO-2 IMPINGER 5-1-3

SAMPLE IDENTITY   03-101
DILUTION FACTOR =   1.00
SAMPLE WEIGHT   =   1.00000

AG = ~~441.800~~ 0.125 % CU = 0.063 SB = < 0.000
AL = 0.110 FE = 0.392 SI = 1.952
BA = 0.177 MG = 0.427 SN = 0.581
BE = 0.000 MN = 0.008 SR = 0.023
B = 2.734 MO = 0.004 TI = 0.004
CA = 4.234 NA = 6.641 V = < 0.000
CD = 0.005 NI = 0.157 ZN = 0.166
CO = 0.018 PB = 0.112 K = 0.939
CR = 0.045 P = 0.119

****

CONCENTRATIONS IN PARTS PER MILLION

EXPLANATION OF SPECIAL SYMBOLS -----

< --- BELOW DETECTION LIMIT

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                     ---ANALYSIS REPORT---
       INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING

SAMPLE IDENTITY      03-102
DILUTION FACTOR =      1.00
SAMPLE WEIGHT   =    1.00000

 AG =        0.274             CU = <    0.000             SB = <    0.000
 AL =        0.139             FE =      0.187             SI =      5.571
 BA =        0.100             MG =      0.280             SN =      1.052
 BE = <      0.000             MN =      0.007             SR =      0.010
 B  =        4.963             MO = <    0.000             TI =      0.003
 CA =        3.361             NA =      2.294             V  = <    0.000
 CD = <      0.000             NI = <    0.000             ZN =      0.166
 CO = <      0.000             PB = <    0.000             K  =      0.062
 CR =        0.005             P  = <    0.000

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CONCENTRATIONS IN PARTS PER MILLION

     EXPLANATION OF SPECIAL SYMBOLS -----

          < --- BELOW DETECTION LIMIT
```

Geo 3

Impinger
5-3-2

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                             10-24-1979

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      INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING
                                              IMPINGER
SAMPLE IDENTITY      03-103      Gr:C4          5-3-3
DILUTION FACTOR =      1.00
SAMPLE WEIGHT   =      1.00000

  AG =       [illegible]  0.569 %     CU =         0.235                       SB =        0.073
  AL =        0.153                   FE =         0.841                       SI =        1.909
  BA =        0.090                   MG =         0.431                       SN =        0.433
  BE =  <     0.000                   MN =         0.024                       SR =        0.019
  B  =        0.597                   MO =  <      0.000                       TI =        0.011
  CA =        3.123                   NA =         3.340                       V  =        0.000
  CD =        0.017                   NI =         1.374                       ZN =        0.407
  CO =        0.100                   PB =         0.374                       K  =        0.556
  CR =        0.130                   P  =         0.289

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CONCENTRATIONS IN PARTS PER MILLION

     EXPLANATION OF SPECIAL SYMBOLS -----

          < --- BELOW DETECTION LIMIT
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     INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING
```

IMPINGER

CIECS 5-4-2

```
SAMPLE IDENTITY      03-104
DILUTION FACTOR =     1.00
SAMPLE WEIGHT   =     1.00000

 AG =       0.470          CU =        0.004          SB =       0.032
 AL =       1.700          FE =        0.273          SI =       2.601
 BA =       1.109          MG =        0.394          SN =       0.295
 BE = <     0.000          MN =        0.007          SR =       0.025
 B  =       2.773          MO =        0.024          TI =       0.012
 CA =       4.321          NA =        5.107          V  =       0.014
 CD =       0.003          NI =  <     0.000          ZN =       0.507
 CO =       0.005          PB =        0.034          K  =       0.398
 CR =       0.025          P  =        0.110
**********************************************************************

CONCENTRATIONS IN PARTS PER MILLION

     EXPLANATION OF SPECIAL SYMBOLS -----

          < --- BELOW DETECTION LIMIT
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REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING

SAMPLE IDENTITY      03-105
DILUTION FACTOR =      1.00
SAMPLE WEIGHT   =      1.00000

AG =     441.400          CU =       0.080          SB =       0.016
AL =       0.163          FE =       1.141          SI =       3.590
BA =       0.127          MG =       0.377          SN =       0.568
BE = <     0.000          MN =       0.018          SR =       0.026
B  =       0.805          MO = <     0.000          TI =       0.008
CA =       3.830          NA =       5.585          V  = <     0.000
CD =       0.017          NI =       0.395          ZN =       0.376
CO =       0.041          PB =       0.141          K  =       1.321
CR =       0.169          P  =       0.119

*********************************************************************

CONCENTRATIONS IN PARTS PER MILLION

     EXPLANATION OF SPECIAL SYMBOLS -----

          < --- BELOW DETECTION LIMIT
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~~[illegible]~~ IMPINGER

GEO-6 5-4-3

AG: ~~441.400~~ 0.146 %

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10-24-1979

---ANALYSIS REPORT---
INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING

EVAP POND WATER

CS-1

SAMPLE IDENTITY 03-109
DILUTION FACTOR = 1.00
SAMPLE WEIGHT = 1.00000

AG =	0.129	CU =	0.070	SB =	0.435
AL =	0.508	FE =	1.634	SI =	0.956
BA =	0.366	MG =	31.350	SN =	0.099
BE = <	0.000	MN =	0.028	SR =	0.894
B =	~~52.012~~ 185-560	MO =	6.906	TI =	0.036
CA =	11.070	NA = %	~~0.217~~ 0.834	V =	0.305
CD =	0.021	NI =	0.765	ZN =	0.102
CO =	0.253	PB =	0.205	K =	56.656
CR =	0.056	P =	1.546		

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CONCENTRATIONS IN PARTS PER MILLION

EXPLANATION OF SPECIAL SYMBOLS -----

< --- BELOW DETECTION LIMIT

% --- PER CENT, NOT PPM

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                                10-24-1979

                          ---ANALYSIS REPORT---
        INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

EQUEST NO. 07040
EQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
NALYSIS PERFORMED BY C. LING
                                                RETORT WATER
AMPLE IDENTITY      03-110       OS-2
ILUTION FACTOR =      1.00
AMPLE WEIGHT   =     1.00000

AG =        0.051                CU =         0.035                SB =        0.113
AL =        0.351                FE =         0.798                SI =        0.309
BA =        0.221                MG =         8.912                SN =        0.050
BE = <      0.000                MN =         0.009                SR =        0.694
B  =        ~~51.692~~ 60.700    MO =         0.267                TI =        0.018
CA =        6.565                NA = %       ~~0.119~~ 0.375      V  =        0.119
CD =        0.018                NI =         0.491                ZN =        0.061
CO =        0.107                PB =         0.141                K  =       29.966
CR =        0.041                P  =         0.745

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CONCENTRATIONS IN PARTS PER MILLION

    EXPLANATION OF SPECIAL SYMBOLS -----

          < --- BELOW DETECTION LIMIT

          % --- PER CENT, NOT PPM
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                       10-24-1979

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    INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING

SAMPLE IDENTITY       03-112
DILUTION FACTOR =       1.00
SAMPLE WEIGHT   =       1.00000

 AG =       1.155              CU =      3.000              SB =      0.254
 AL =       0.264              FE =      0.045              SI =     41.512
 BA =       0.002              MG =      0.013              SN =      0.046
 BE =  <    0.000              MN =     10.780              SR =      0.004
 B  =      ~~51.980~~ 60.020         MO =      0.019              TI =      0.008
 CA =       0.082              NA =     ~~66.824~~ 53.508       V  =      0.026
 CD =       2.232              NI =      4.114              ZN =      5.543
 CO =       4.262              PB =     21.735              K  =      3.691
 CR =       5.497              P  =      0.988
****************************************************************************

CONCENTRATIONS IN PARTS PER MILLION

    EXPLANATION OF SPECIAL SYMBOLS -----

        < -*- BELOW DETECTION LIMIT
```

TM-Ni Con

QC
SEE TRUE VALUES
ATTACHED

```
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                           10-24-1979

                    ---ANALYSIS REPORT---
    INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROSCOPY

REQUEST NO. 07040
REQUESTED BY J. WORKMAN, DAYTON-MRC, OIL SHALE
ANALYSIS PERFORMED BY C. LING

SAMPLE IDENTITY      03-113
DILUTION FACTOR =      1.00
SAMPLE WEIGHT   =      1.00000
```

TNT Ki @ 10/1000

GC - SEE TRUE VALUES ATTACHED

```
 AG = <     0.000            CU =        0.033            SB = <     0.000
 AL =       0.031            FE =        0.031            SI =       0.432
 BA =       0.002            MG =        0.014            SN = <     0.000
 BE =       0.000            MN =        0.090            SR =       0.002
 B  =       0.626            MO =        0.002            TI =       0.000
 CA =       0.079            NA =        0.738            V  =       0.006
 CD =       0.021            NI =        0.052            ZN =       0.056
 CO =       0.046            PB =        0.208            K  =       0.066
 CR =       0.047            P  =        0.076

**************************************************************************

CONCENTRATIONS IN PARTS PER MILLION

     EXPLANATION OF SPECIAL SYMBOLS -----

          < --- BELOW DETECTION LIMIT
```

Oil Shale

As Se Hg Tl ICAP

1.79.08.02.03 104.0136

Fill Back 2

Filters		Wt. Grams	Dil Vol (ml)
145078 - 1	5-1-F	0.4021	250
145078 - 2	5-3-F	0.0832	250
145078 - 3	5-B-F	0.0021	250

Sent [illegible]

Impingers		AA Desig.	Initial mls	Final
Digest 1412240	5-1-2	GEO-1	307	100
	5-1-3	GEO-2	780	100
	5-3-2	GEO-3	475	100
	5-3-3	GEO-4	505	100
	5-4-2	GEO 5	585	100
	5-4-3	GEO 6	1040	100

Arsine Imp		Initial mls	Final	AA Desig
1412245 Digest.	ID-1-Ar	62	100	OS C
	ID-2-Ar	85	100	CS D
	OD-1-Ar	90	100	CS A
	OD-2-Ar	76	100	CS B

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TABLE E-1. COMPARISON OF TRUE AND MEASURED CONCENTRATIONS IN QUALITY CONTROL SAMPLES ANALYZED BY INDUCTIVELY COUPLED ARGON PLASMA OPTICAL EMISSION SPECTROSCOPY

	Concentration, mg/L			
	Concentrated sample		Diluted sample	
Element	True	Measured	True	Measured
Boron	60	60.02	0.60	0.63
Cadmium	2	2.23	0.02	0.02
Chromium	5	5.50	0.05	0.05
Cobalt	4	4.26	0.04	0.05
Copper	3	3.00	0.03	0.03
Lead	20	21.74	0.20	0.21
Manganese	10	10.78	0.10	0.10
Nickel	4	4.11	0.04	0.05
Silicon	40	41.51	0.40	0.43
Zinc	5	5.54	0.05	0.06

ANALYSIS REPORT	DATE 9. NOV. 79	cc:Files
TO G. RINALDI	RECORD NUMBER 1·79·08·02-10	
FROM **ANALYTICAL SERVICES** MONSANTO RESEARCH CORPORATION Dayton, Ohio	PROJECT NUMBER 13·022·76051·104·0136 NOTEBOOK/REFERENCE DATA ATTACHED	

Title: Oil SHALE

Method: ATOMIC ABSORPTION

TWO SAMPLES WERE RECEIVED FOR DETERMINATION OF ARSENIC SELENIUM, MERCURY AND THALLIUM. DATA BELOW APPEAR IN UNITS OF MICROGRAMS OF ANALYTE PER MILLILITER OF SAMPLE

SAMPLE	As	Se	Hg	Tl
EVAP. POND WATER	15.0	0.283	0.028	<0.05
RETORT WATER	1.58	0.018	0.037	<0.05

Total metals – dissolved + suspended

Digestion THUSITES
Analysis JGUST

ANALYST:

ANALYSIS REPORT

DATE 9. NOV. 79

cc:Files

TO. G. RINALDI

RECORD NUMBER 1.79.08.02.02/1.79.08.02.03

FROM

ANALYTICAL SERVICES
MONSANTO RESEARCH CORPORATION
Dayton, Ohio

PROJECT NUMBER 13.022.760.51-104.0136

NOTEBOOK REFERENCE DATA ATTACHED

Title: OIL SHALE/GEOKINETICS

Method: ATOMIC ABSORPTION

ATTACHED is A DATA SUMMARY OF A.A. WORK DONE ON THE OIL SHALE SAMPLES.

SAMPLE PREPARATION WAS ACCOMPLISHED AS FOLLOWS:

-ALL IMPINGERS - ACIDIFY AND EVAPORATE TO LOW VOLUME, DIGEST WITH CON. HNO_3, DILUTE TOO 100 ml.

Filters - PARR Bomb with CON. HNO_3, DILUTE TO 250 ml.

Analytical Method USED:

ARSENIC - HYDRIDE VAPOR GENERATION A.A. with BACKGROUND CORRECTION

SELENIUM - SAME AS ARSENIC

MERCURY - Cold VAPOR A.A. USING HEATED Cell.

DIGESTION: PAVLIKS/J.GIUST/C.CHURCH
Analysis: J.GIUST

ANALYST:

Oil SHALE

SUMMARY

1·79·08·02·02 +
~~1·79·08·02~~= 0
1·79·08·02·03

(I) ARSINE IMPINGERS (100 ml)

SAMPLE	initial ** IMPINGER VOL. (Mls)	TOTAL MICROGRAMS (μg) As FOUND IN IMPINGER
OD-1-AR	90	<0.1
OD-2-AR	76	12.9
ID-1-AR	62	<0.1
ID-2-AR	85	0.1

(II) Other IMPINGERS (100 ml)

SAMPLE	INITIAL IMPINGER VOL. (Mls)	TOTAL MICROGRAMS (μg) FOUND IN EACH IMPINGER		
		As	Se	Hg
5-1-2	307	64.9	<0.5	<0.1
5-1-3	780	26.6	<0.5	1.0
5-3-2	475	0.3	7.7	0.1
5-3-3	905	0.4	<0.5	0.2
5-4-2	585	51.1	0.8	0.3
5-4-3	1090	12.9	<0.5	4.3

(III) Filters (250 ml)

SAMPLE	NET WT # (GRAMS)	TOTAL MICROGRAMS μg FOUND ON EACH FILTER	
		As	SE
5-1-F	0.4021	15.0	2.5
5-3-F	0.0832	11.0	1.3
5-B-F	0.0021	<0.3	<0.3

**As rec'd from Field.

#final g - presample g.

Oil Shale

Arsine Impingers

$(x)\ \mu g/ml \times \frac{100\ ml}{1} =$ µg As in sample (TOTAL µg in impinger)

	µg/ml	TOTAL µg As / impinger
[illegible]	<001	<0.1
[illegible]	.129	12.9
[illegible]	<001	<0.1
[illegible]	<001	<0.1

Filters

$(x)\ \mu g/ml \times 250\ ml$ - TOTAL µg on Filter

		As µg/ml	As TOTAL	SE µg/ml	SE TOTAL
1415078-1	[illegible]	0.060	15.0	0.010	2.5
-2	[illegible]	0.044	11.0	0.005	1.3
-3	[illegible]	<0.001	<0.25	<0.001	<0.5

Other Impingers

$(x)\ \mu g/ml \times 100\ ml =$ TOTAL µg in Sample

		µg/ml As	As TOTAL	SE µg/ml	SE TOTAL	Hg µg/ml	Hg TOTAL
GED	[illegible]	0.049	[illegible]	<005	<0.5	<0.001	<0.1
	[illegible]	0.266	26.6	<005	<0.5	0.010	[illegible]
	[illegible]	0.003	0.3	0.077	[illegible]	0.001	0.1
	[illegible]	0.004	[illegible]	<0.005	<0.5	0.002	0.2
	[illegible]	0.511	51.1	0.008	0.8	0.003	0.3
	6	0.129	12.9	<0.005	<0.5	0.043	[illegible]

Oil SHALE

All as µg/ml in Ad spl.

Raw Ad Data

	As	Se	Hg	Tl
OS A	<001	NR	NR — Not REQUESTED	
B	.129	"	"	
C	<001	"	"	
D	001	"	"	
GEO 1	0.649	<005	<001	
2	0.266	<005	.010	
3	0.003	.077	001	
4	0.004	<005	002	
5	0.511	008	003	
6	0.129	<005	043	
OS 1	15.0	0.283	0.028	<.05
OS 2	1.58	0.018	0.037	<.05
5-1-F	.060	.010	NR	
5-3-F	.044	005	"	
5-B-F	<001	<001	"	

TABLE E-2. DETECTION LIMITS AND LOWEST QUANTITATIVELY DETERMINABLE CONCENTRATIONS FOR METALS ANALYSES

Atomic absorption metals analysis	
Element	Detection limit, mg/liter
Arsenic	0.001
Mercury	0.0007
Selenium	0.001
Thallium	0.050

ICAP metals analysis		
Element	Detection limit, mg/liter	LQDC,[a] mg/liter
Aluminum	0.012	0.060
Antimony	0.010	0.050
Barium	0.0002	0.001
Beryllium	0.00004	0.0002
Boron	0.001	0.005
Cadmium	0.002	0.010
Calcium	0.00004	0.0002
Chromium	0.004	0.020
Cobalt	0.006	0.030
Copper	0.004	0.020
Iron	0.002	0.010
Lead	0.022	0.110
Magnesium	0.0001	0.0005
Manganese	0.0005	0.003
Molybdenum	0.010	0.050
Nickel	0.036	0.180
Phosphorus	0.070	0.700
Silicon	0.015	0.075
Silver	0.005	0.025
Sodium	0.026	0.260
Strontium	0.0002	0.001
Tin	0.015	0.075
Titanium	0.001	0.005
Vanadium	0.002	0.010
Zinc	0.001	0.005

[a] Lowest quantitatively determinable concentration (95% confidence limits).

TABLE E-3. MASSES OF TRACE ELEMENTS COLLECTED FROM FILTER SAMPLES OF GEOKINETICS GAS STREAMS[a]

Element	Filter blank	Demister outlet: Uncorrected	Demister outlet: Corrected[c]	Incinerator outlet: Uncorrected	Incinerator outlet: Corrected[c]
	Mass collected,[b] µg				
Aluminum	140	110	BDL[d]	85	BDL
Antimony	6	4	BDL	2[e]	BDL
Arsenic[f]	BDL	15	15	11	11
Barium	10	3	BDL	1	BDL
Beryllium	BDL	BDL	BDL	BDL	BDL
Boron	140	250	110	47	BDL
Cadmium	2[e]	2[e]	BDL	1[e]	BDL
Calcium	822	855	33	580	BDL
Chromium	2[e]	2[e]	BDL	1[e]	BDL
Cobalt	1[e]	2[e]	1[e]	2[e]	1[e]
Copper	5[e]	5[e]	BDL	4[e]	BDL
Iron	18	38	20	18	BDL
Lead	15[e]	34	19[e]	9[e]	BDL
Magnesium	210	200	BDL	120	BDL
Manganese	1[e]	1[e]	BDL	BDL	BDL
Molybdenum	4[e]	5[e]	1[e]	1[e]	BDL
Nickel	32[e]	28[e]	BDL	16[e]	BDL
Phosphorus	34[e]	20[e]	BDL	10[e]	BDL
Potassium	344	447	103	253	BDL
Selenium[f]	BDL	2	2	1	1
Silicon	210	130	BDL	130	BDL
Silver	7	3[e]	BDL	BDL	BDL
Sodium	10,490	10,780	290	10,110	BDL
Strontium	2	1	BDL	1	BDL
Tin	4[e]	47	43	30	26
Titanium	2	2	BDL	2	BDL
Vanadium	5	4	BDL	3	BDL
Zinc	9	8	BDL	5	BDL

[a] Analyses by inductively coupled argon plasma optical emission spectroscopy, except as noted.

[b] Products of reported concentrations (µg/mL) and dilution volume of 250 mL.

[c] Calculated by subtraction of mass collected from filter blank from total mass collected from sample filter. If value for filter blank is greater than the uncorrected sample value, the corrected sample value is reported as being below the detection limit.

[d] Below detection limit (see Table E-2).

[e] Concentration was in the semi-quantitative range between the detection limit and the LQDC (see Table E-2).

[f] Analysis by atomic absorption.

TABLE E-4. MASSES OF VOLATILE TRACE ELEMENTS COLLECTED FROM IMPINGER SAMPLES OF GEOKINETICS GAS STREAMS

	Mass collected,[a] µg								
	Demister inlet			Demister outlet			Incinerator outlet		
Element	5-1-2[b]	5-1-3[c]	Total	5-4-2[b]	5-4-3[c]	Total	5-3-2[b]	5-3-3[c]	Total
Antimony[d]	1.5	BDL[e]	1.5	3.2	1.6	4.8	BDL	7.3	7.3
Arsenic[f]	64.9	26.6	91.5	51.1	12.9	64.0	0.3	0.4	0.7
Cadmium[d]	0.2	0.5	0.7	0.3	1.7	2.0	BDL	1.7	1.7
Lead[d]	1.6	11.2	12.8	3.4	14.1	17.5	BDL	37.4	37.4
Mercury[f]	BDL	1.0	1.0	0.3	4.3	4.6	0.1	0.2	0.3
Selenium[f]	BDL	BDL	BDL	0.8	BDL	0.8	7.7	BDL	7.7

[a] Products of reported concentrations (µg/mL) and dilution volume of 100 mL.

[b] First impinger, which contained a 6 M H_2O_2 solution.

[c] Combination of second and third impingers, which contained a solution of 0.2 M $(NH_4)_2 S_2O_8$ catalyzed by 0.02 M $AgNO_3$.

[d] Analysis by inductively coupled argon plasma optical emission spectroscopy.

[e] Below detection limit (see Table E-2).

[f] Analysis by atomic absorption.

APPENDIX F

FIELD AND ANALYTICAL DATA FOR BIOASSAY TESTING BY MRC

The field data sheets for two samples of the demister outlet gases at Geokinetics Retort No. 17 using the Source Assessment Sampling System are presented in this Appendix. Following are computer printouts of data from the Ames mutagenicity assays and CHO cytotoxicity assays of the filter and resin extracts as determined by MRC.

FIELD DATA

PLANT Geokinetics
DATE [illegible] 7/23/79
SAMPLING LOCATION Outlet Demister
SAMPLE TYPE [illegible] RIO - SASS
RUN NUMBER I SASS-1
OPERATOR [illegible] STERLING
AMBIENT TEMPERATURE 92
BAROMETRIC PRESSURE 23.60
STATIC PRESSURE, (P_s) .09
FILTER NUMBER (s) 206660-11

PROBE LENGTH AND TYPE 3' S.S.
NOZZLE I.D. .900
ASSUMED MOISTURE, % 17
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp

8 50

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY ______ MINUTES LEAK RATE .06 CFM @ 30"Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	Probe
					DESIRED	ACTUAL		INLET $(T_{m\ in})$, °F	OUTLET $(T_{m\ out})$, °F				
		[illegible]	842.237										
	[illegible]	1814	842.237	.19	2.0	2.0	113	91	95	15.0	370	68	113
	5	1819	859.000	.19	2.0	2.0	112	92	95	150	375	67	112
	10	1824	869.300	.19	2.0	.6	112	94	95	19.0	375	64	112
	15	1829	879.900	.19	2.0	.6	112	95	95	19.0	375	64	112
	20	1834	891.510	.19	2.0	.6	113	100	95	20.0	350	75	114
	25	1839	903.250	.19	2.0	.6	114	103	96	20.0	345	78	114
	30	1844	914.650	.19	2.0	.6	114	109	97	19.0	335	90	114
	35	1849	926.745	.20	2.0	.55	114	104	98	19.0	313	91	114
	40	1854	938.425	.20	2.0	.55	115	105	98	20.0	299	91	116
	45	1859	950.230	.20	2.0	.55	120	105	99	20.0	308	93	122
	50	1904	961.900	.20	2.0	.55	120	103	99	20.0	305	92	123
	55	1909	973.810	.20	2.0	.55	120	101	100	20.0	300	90	125
	60	1914	985.650	.19	2.0	.55	119	100	101	20.0	302	90	124
	65	1919	997.520	.19	2.0	.55	117	99	101	20.0	299	89	123
	70	1924	1010.015	.19	2.0	1.00	117	95	101	12.5	302	89	122
	75	1929	1025.000	.19	2.0	1.00	120	92	99	17.5	305	87	123

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PLANT Geokinetics DATE 7/23/79 RUN NO. 1 - SASS- BIO

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	Probe	SA
					DESIRED	ACTUAL		INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F					
		1929	1025.00											
80	1924	1934	1040.285	.185	2.0	1.0	121	91	99	17.5	302	87	112	8
85	[illegible]	1939	1055.951	.185	2.0	1.0	121	89	97	17.5	304	85	121	8
90	[illegible]	[illegible]	1071.800	.185	2.0	.95	122	87	95	18.0	300	83	121	8
95	1949	[illegible]	1087.420	.180	2.0	.95	122	86	94	18.0	299	83	121	[illegible]
100	[illegible]	1954	1102.950	.180	2.0	.90	122	84	92	18.0	302	82	119	8
105	[illegible]	1959	1118.250	.185	2.0	.90	120	83	89	18.0	299	77	111	7
110	2004	2004	1133.918	.18	2.0	.90	119	83	89	18.0	298	77	115	7
115	[illegible]	2009	1148.160	.18	2.0	.75	117	82	87	18.0	298	77	113	7
120	2014	2014	1162.310	.18	2.0	.75	116	83	87	18.0	288	74	112	7
125	2019	2019	1176.160	.18	2.0	.70	115	83	86	18.0	299	74	113	7
130	[illegible]	2024	1190.065	.18	2.0	.70	113	84	86	18.0	311	73	111	7
135	[illegible]	2029	1203.720											

End of Run

Run Called Because of Darkness

CLEAN-UP DATA

Plant Geokinetic **Comments:**

Date 7/23/79

Sampling Location Outlet Demister

Sample Type SASS

Run Number 1

Sample Box Number

Clean-up Man Sterling, McDonald

IMPINGERS

	#1	#2	#3	#4	#5
Final Vol.	ml	ml	ml	ml	ml
Initial Vol.	500 ml	500 ml	ml	ml	ml
Net Vol.	ml	ml	ml	ml	ml

Total Net Volume in Impingers ml

SILICA GEL

Final Weight	g	g	g
Initial Weight	750 g	750 g	g
Net Weight	g	g	g

Total Net Weight in Silica Gel g

Total Moisture g

Filter Number(s) 206660-11 2.6825 gm.

MRC 7/73

FIELD DATA

PLANT Geokinetics
DATE 7/24/79
SAMPLING LOCATION Outlet Demistor
SAMPLE TYPE BIO-SASS
RUN NUMBER SASS-2
OPERATOR STEARLINE
AMBIENT TEMPERATURE 180°
BAROMETRIC PRESSURE
STATIC PRESSURE, (P_s)
FILTER NUMBER (s) 106680" 1A

PROBE LENGTH AND TYPE 3' S.S
NOZZLE I.D. .500
ASSUMED MOISTURE, % 12
SAMPLE BOX NUMBER
METER BOX NUMBER
METER $\Delta H_@$
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES LEAK RATE .04 CFM @ 20" Hg

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	Probe	XAD
					DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F					
			204.275											
		1330	204.275	.20	2.0	1.0	113	104	105	18.0	381	91	112	90
		1335	214.810	.205	2.0	.90	111	104	105	18.5	380	86	109	92
		[illegible]	229 980	.20	2.0	.90	107	104	104	18.5	385	90	108	91
		[illegible]	245.000	.20	2.0	.90	102	104	103	18.5	383	93	105	91
		[illegible]	259.650	.20	2.0	.90	102	104	103	18.0	380	96	106	92
		[illegible]	274.700	.20	2.0	.90	103	104	103	18.0	350	94	106	90
		[illegible]	289.760	.20	2.0	.95	103	104	102	18.0	335	93	106	85
		1405	304.760	.20	2.0	.45	103	104	102	18.0	300	91	103	79
		1410	314.885	.20	2.0	.90	104	104	100	18.0	319	89	108	72
		1415	334.960	.20	2.0	.90	105	107	102	18.0	324	87	110	71
	[illegible]	1420	350.000	.20	2.0	.90	105	104	100	18.0	290	88	111	68
	55	1425	365.035	.21	2.0	.90	107	106	100	18.0	315	85	113	65
	60	1430	380.050	.21	2.0	.90	115	110	103	18.0	315	84	120	67
	65	1435	395.210	.21	2.0	.90	113	108	103	18.0	330	86	120	68
	70	1440	410.035	.21	2.0	.90	112	108	104	18.0	350	88	118	69
	75	1445	425.420	.21	2.0	.90	113	107	104	18.0	323	89	119	70

PLANT [illegible] DATE 7/24/79 RUN NO. BIO-SASS II

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	[illegible]
					DESIRED	ACTUAL		INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F				
	80	1450	440.340	.21	2.0	.90	111	109	104	18.0	276	84	117
	85	1455	455.210	.21	2.0	.90	113	105	103	18.0	250	83	118
	90	1500	470.150	.21	2.0	.90	112	106	104	18.0	255	88	118
	95	1505	485.372	.21	1.0	.90	112	104	103	18.0	283	87	118
	100	1510	500.350	.21	2.0	.90	115	103	103	18.0	291	91	120
	105	1515	516.785	.21	2.0	.85	114	104	103	18.0	304	85	118
	110	1520	531.695	.21	2.0	.85	115	104	103	18.0	300	86	119
	115	1525	547.162	.21	2.0	.85	116	105	103	18.0	300	87	119
	120	1530	563.084	.21	2.0	.85	116	105	103	18.0	295	88	120
	125	1535	569.321	.21	2.0	.85	118	105	103	18.0	288	91	121
	130	1540	581.510	.21	2.0	.85	116	105	104	18.0	295	98	127
	135	1545	594.650	.21	2.0	.65	121	109	106		303	102	128
	140	1550	608.342										

End of Run.

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```
SAMPLE ID:    LOG#79-8-31-115 OIL SHALE FILTER EXTRACT
STRAINS:      TA98            TA100           TA1535          TA1537
TEST DATES:   9/12/79         9/12/79         9/12/79         9/12/79
DATA REF:     1577536         1567536         1567536         1567536
S-9 REF:      CE097 10%
SOLVENT       DMSO 10UL
--------------------------------------------------------------------------
WITH MICROSOMAL
ACTIVATION
------------------
                              REVERTANTS/PLATE
                   -------------------------------------------------------
  AMOUNT/PLATE(UL)   TA98          TA100          TA1535         TA1537
--------------------------------------------------------------------------

       10          227 138 205   268 210 288   22  14  21     22  11  13
       3           137 178 199   208 227 208   16  10  17     8   12  14
       1           168 186 196   220 226 211   14  18  25     17  13  6
       .2          109 105 119   247 276 233   29  14  18     16  15  11
       .04         57  52  56    210 138 189   21  22  24     10  12  16
       .01         28  43  47    122 141 172   16  11  19     10  13  9

  CONTROLS
  --------
  SOLVENT          42  36  34    201 162 215   21  18  15     11  8   9
  NEGATIVE         35  -1  -1    165 -1  -1    18  -1  -1     12  -1  -1
  POSITIVE             336           516           320            176
--------------------------------------------------------------------------
WITH MICROSOMAL
ACTIVATION
------------------
                              T VALUES
                   -------------------------------------------------------
  AMOUNT/PLATE(UL)   TA98          TA100          TA1535         TA1537
--------------------------------------------------------------------------

       10          *11.458        2.4426         .205589        1.82712
       3           *10.7931       .984841        -1.14687       .700531
       1           *11.3456       1.17685        .1645          .68267
       .2          *7.77739       2.38374        .396227        1.59484
       .04          2.78187       -.714082       1.04713        1.173
       .01          .22785        -2.50587       -.824404       .516873

* DENOTES A RESPONSE SIGNIFICANTLY DIFFERENT FROM CONTROLS
AT P<0.01 LEVEL
DEGREES OF FREEDOM 14
```

```
SAMPLE ID:    LOG#79-8-31-115 OIL SHALE FILTER EXTRACT
STRAINS:      TA98           TA100          TA1535         TA1537
TEST DATES:   9/12/79        9/12/79        9/12/79        9/12/79
DATA REF:     1567536        1567536        1567536        1567536
S-9 REF:      NONE
SOLVENT       DMSO 10UL
-----------------------------------------------------------------------------
WITHOUT MICROSOMAL
ACTIVATION
------------------

                              REVERTANTS/PLATE
                   ----------------------------------------------------------
  AMOUNT/PLATE(UL)     TA98          TA100          TA1535         TA1537
-----------------------------------------------------------------------------

        10           28  28  30    116 137 167    11  10  11     8   7   8
        3            47  26  28    134 145 168    18  17  15     8   11  8
        1            36  23  33    190 183 185    12  13  22     11  15  3
        .2           30  15  20    179 166 113    25  13  22     9   7   4
        .04          24  19  36    198 163 149    18  21  22     13  7   6
        .01          32  33  29    178 196 179    11  25  8      11  9   6

  CONTROLS
  --------

  SOLVENT            36  45  24    217 210 215    21  15  30     13  4   9
  NEGATIVE           21  -1  -1    165 -1  -1     14  -1  -1     7   -1  -1
  POSITIVE               506           585            488            22
-----------------------------------------------------------------------------
WITHOUT MICROSOMAL
ACTIVATION
------------------

                              T VALUES
                   ----------------------------------------------------------
  AMOUNT/PLATE(UL)     TA98          TA100          TA1535         TA1537
-----------------------------------------------------------------------------

        10           -.77242       -3.88301       -2.62172       -3.76764E-02
        3            -.196376      -3.26767       -.921102       .352239
        1            -.542036      -1.25097       -1.29195       4.83877E-02
        .2           -2.24867      -3.18377       -.355747       -.534029
        .04          -1.32503      -2.11584       -.163053       .132983
        .01          -.366819      -1.33892       -1.85916       .205672

* DENOTES A RESPONSE SIGNIFICANTLY DIFFERENT FROM CONTROLS
AT P<0.01 LEVEL
DEGREES OF FREEDOM 14
```

CLASSIFICATION
ELITE
PICA

```
SAMPLE ID:     LOG#79-8-31-114 OIL SHALE XAD EXTRACT
STRAINS:       TA98                                 TA1535
TEST DATES:    9/11/79                              9/11/79
DATA REF:      1567534                              1567534
S-9 REF:       CE097 10%
SOLVENT        DMSO 10UL
------------------------------------------------------------------------------
WITH MICROSOMAL
ACTIVATION
------------------

                               REVERTANTS/PLATE
                  -------------------------------------------------------------
 AMOUNT/PLATE(UL)   TA98                                TA1535
-------------------------------------------------------------------------------

     10      .      47  36  44    -1  -1  -1    11  13  6     -1  -1  -1
     3              35  30  32    -1  -1  -1    11  10  12    -1  -1  -1
     1              26  31  33    -1  -1  -1    12  13  12    -1  -1  -1
     .2             31  36  32    -1  -1  -1    13  12  10    -1  -1  -1
     .04            38  31  36    -1  -1  -1    13  8   12    -1  -1  -1
     .01            27  41  32    -1  -1  -1    12  10  11    -1  -1  -1
 CONTROLS
 --------
 SOLVENT            38  39  32    -1  -1  -1    14  15  12    -1  -1  -1
 NEGATIVE           35  -1  -1    -1  -1  -1    17  -1  -1    -1  -1  -1
 POSITIVE               220           -1            340           -1
-------------------------------------------------------------------------------
WITH MICROSOMAL
ACTIVATION
------------------

                               T VALUES
                  -------------------------------------------------------------
 AMOUNT/PLATE(UL)   TA98                                TA1535
-------------------------------------------------------------------------------

     10             1.44543     --1                 -2.18688      --1
     3              -1.1045     --1                 -1.31249      --1
     1              -1.85352    --1                 -.603346      --1
     .2             -.909119    --1                 -.973416      --1
     .04            -.358305    --1                 -1.42634      --1
     .01            -.93507     --1                 -1.31249      --1

* DENOTES A RESPONSE SIGNIFICANTLY DIFFERENT FROM CONTROLS
AT P<0.01 LEVEL
DEGREES OF FREEDOM 14
```

SIX TYPING LINES REMAIN
LAST LINE

CLASSIFICATION

```
TEST NUMBER           79-8-31-114
DATA REFERENCE         1567534
STRAIN                 TA100 WITH S-9

CONTROL
         10          1            UL OF SAMPLE
                                   .2          .04          .01

189      194         124          123          109          134
173      149         165          112          115          123
144      156         169          151          126          123

T=       -.136647    -.976703     -2.58434     -3.45561     -2.66582

* DENOTES A RESPONSE SIGNIFICANTLY DIFFERENT FROM CONTROLS
AT THE P<0.01 LEVEL.
DEGREES OF FREEDOM = 12
```

```
TEST NUMBER        79-8-31-114
DATA REFERENCE      1567534
STRAIN              TA1537 WITH S-9

CONTROL                          UL OF SAMPLE
           10          1           .2          .04          .01

9          6           9           11          10           8
10         7           10          13          7            11
8          9           11          13          10           12

T=         -1.60239    .791929     2.35883     -.070058     .952423

* DENOTES A RESPONSE SIGNIFICANTLY DIFFERENT FROM CONTROLS
AT THE P<0.01 LEVEL.
DEGREES OF FREEDOM = 12
```

```
SAMPLE ID:    LOG#79-8-31-114 OIL SHALE XAD EXTRACT
STRAINS:      TA98                                    TA1535
TEST DATES:   9/11/79                                 9/11/79
DATA REF:     1567534                                 1567534
S-9 REF:      NONE
SOLVENT       DMSO 10UL
-----------------------------------------------------------------
WITHOUT MICROSOMAL
ACTIVATION
-------------------

                           REVERTANTS/PLATE
                    ---------------------------------------------
  AMOUNT/PLATE(UL)    TA98                          TA1535
-----------------------------------------------------------------

       10           28  26  33    -1  -1  -1    21  23  19    -1  -1  -1
       3            28  22  15    -1  -1  -1    15  10  9     -1  -1  -1
       1            14  22  14    -1  -1  -1    20  9   16    -1  -1  -1
       .2           16  30  33    -1  -1  -1    23  24  9     -1  -1  -1
       .04          21  24  32    -1  -1  -1    17  11  20    -1  -1  -1
       .01          21  29  24    -1  -1  -1    19  15  23    -1  -1  -1

   CONTROLS
   --------
   SOLVENT          37  17  25    -1  -1  -1    20  24  23    -1  -1  -1
   NEGATIVE         22  -1  -1    -1  -1  -1    14  -1  -1    -1  -1  -1
   POSITIVE             347           -1            374           -1
-----------------------------------------------------------------
WITHOUT MICROSOMAL
ACTIVATION
-------------------

                           T VALUES
                    ---------------------------------------------
  AMOUNT/PLATE(UL)    TA98                          TA1535
-----------------------------------------------------------------

       10           .61137          --1          -.237011        --1
       3            -.767037        --1          -2.69475        --1
       1            -1.86649        --1          -1.72314        --1
       .2           1.05109E-02     --1          -1.02397        --1
       .04          3.65053E-02     --1          -1.38807        --1
       .01          -.105503        --1          -.668484        --1

* DENOTES A RESPONSE SIGNIFICANTLY DIFFERENT FROM CONTROLS
AT P<0.01 LEVEL
DEGREES OF FREEDOM 14
```

```
TEST NUMBER         79-8-31-114
DATA REFERENCE       1567534
STRAIN               TA100WITHOUT  S-9

CONTROL
        10          1          UL OF SAMPLE
                                .2          .04          .01

191     144         149        210          192          157
173     148         102        186          147          186
196     210         141        156          210          161

T=      -.936905    -2.80404   -.15457      -.224727     -.812007

* DENOTES A RESPONSE SIGNIFICANTLY DIFFERENT FROM CONTROLS
AT THE P<0.01 LEVEL.
DEGREES OF FREEDOM = 12
```

```
TEST NUMBER         79-8-31-114
DATA REFERENCE       1567534
STRAIN               TA1537WITHOUT S-9

CONTROL                         UL OF SAMPLE
         10         1          .2         .04         .01

12       8          7          7          7           3
10       7          5          8          8           9
11       6          9          7          6           7

T=     -1.98733   -2.08107   -1.76343   -1.98733    -2.82301

* DENOTES A RESPONSE SIGNIFICANTLY DIFFERENT FROM CONTROLS
AT THE P<0.01 LEVEL.
DEGREES OF FREEDOM = 12
```

```
CYTOTOXICITY DATA FOR LOG#79-8-31-115 FILTER EXTRACT      9/17/79
CELL LINE: CHO-K1                                         PAGE REF: 1415933


   CONTROL
(BACKGROUND)                       MEAN                       STANDARD
   VALUES                          VALUE                      DEVIATION
------------                       -----                      ---------
     538                            511                          54
     534
     523
     445
     447
     581


CONCENTRATION       REPLICATE       MEAN        STANDARD        PERCENT
   (UL/ML)            VALUES        VALUE       DEVIATION       SURVIVAL
-------------       ---------       ------      ---------       --------

  50                    0            0             0               0
                        0
                        0

  30                    0            0             0               0
                        0
                        0

  20                    0            0             0               0
                        0
                        0

  15                    0            0             0               0
                        0
                        0

  10                    0            0             0               0
                        0
                        0

  6                     0            0             0               0
                        0
                        0

  4                     0            0             0               0
                        0
                        0

  2                     0            0             0               0
                        0
                        0

  1                     0            0             0               0
                        0
                        0

  .5                    6            84            111             16
                        211
                        36
```

CYTOTOXICITY DATA FOR LOG#79-B-31-114 XAD EXTRACT 9/17/79
CELL LINE: CHO-K1 PAGE REF: 1415933

- CONTROL (BACKGROUND) VALUES	MEAN VALUE	STANDARD DEVIATION
538	511	54
534		
523		
445		
447		
581		

CONCENTRATION (UL/ML)	REPLICATE VALUES	MEAN VALUE	STANDARD DEVIATION	PERCENT SURVIVAL
50	0 0 0	0	0	0
30	0 0 0	0	0	0
20	0 0 0	0	0	0
15	0 0 0	0	0	0
10	0 0 0	0	0	0
6	0 0 0	0	0	0
4	0 0 0	0	0	0
2	0 0 0	0	0	0
1	0 0 0	0	0	0
.5	0 99 0	33	57	6

```
CYTOTOXICITY DATA FOR CADMIUM CHLORIDE                         9/17/79
CELL LINE: CHO-K1                                              PAGE REF: 1415933


   CONTROL
(BACKGROUND)                          MEAN                                STANDARD
   VALUES                             VALUE                               DEVIATION
------------                          -----                               ---------
    538                                511                                  54
    534
    523
    445
    447
    581


CONCENTRATION         REPLICATE       MEAN          STANDARD          PERCENT
   (UG/ML)              VALUES        VALUE         DEVIATION         SURVIVAL
-------------         ---------       ------        ---------         --------

  1                      0              0              0                 0
                         0
                         0

  .5                     0              0              0                 0
                         0
                         0

  .4                     0              0              0                 0
                         0
                         0

  .3                     0              0              0                 0
                         0
                         0

  .2                     4              5              3                 1
                         8
                         2

  .1                    549            531             19               100
                        534
                        511
```

APPENDIX G

CALIBRATION DATA AND SAMPLING AND ANALYSIS RESULTS FROM FUGITIVE EMISSION MEASUREMENTS

Data relevant to sampling and analysis of fugitive emissions from Geokinetics Retort No. 17 are included in this Appendix. Calibration data necessary to obtain a known gas flow rate from brass and stainless steel orifice meters used are presented in both tabular and graphic form. Input data and output from gas flow rate determination using the method described in Section 5 are also listed. The appendix concludes with results of gas chromatographic analyses for total hydrocarbons and C_1 to C_6 hydrocarbon fractions and Orsat analyses of fugitive emission samples.

TABLE G-1. CALIBRATION DATA FOR FUGITIVE EMISSION SAMPLING TRAIN - BRASS ORIFICE[a]

Pressure drop across orifice, in H_2O	Run time, min	Volume of gas, ft^3	Flow rate, ft^3/min
0.25	20	5.24	0.26
0.40	21	7.16	0.34
0.50	14	5.22	0.37
0.60	13	5.12	0.39
0.75	12	5.56	0.46
1.0	10	5.24	0.52
1.5	8	5.16	0.64
2.0	7	5.26	0.75
2.5	7	5.45	0.78
3.0	6	5.40	0.90
4.0	7	6.56	0.94

[a] Barometric pressure during calibration = 29.30 in Hg; temperature during calibration = 75°F = 535°R.

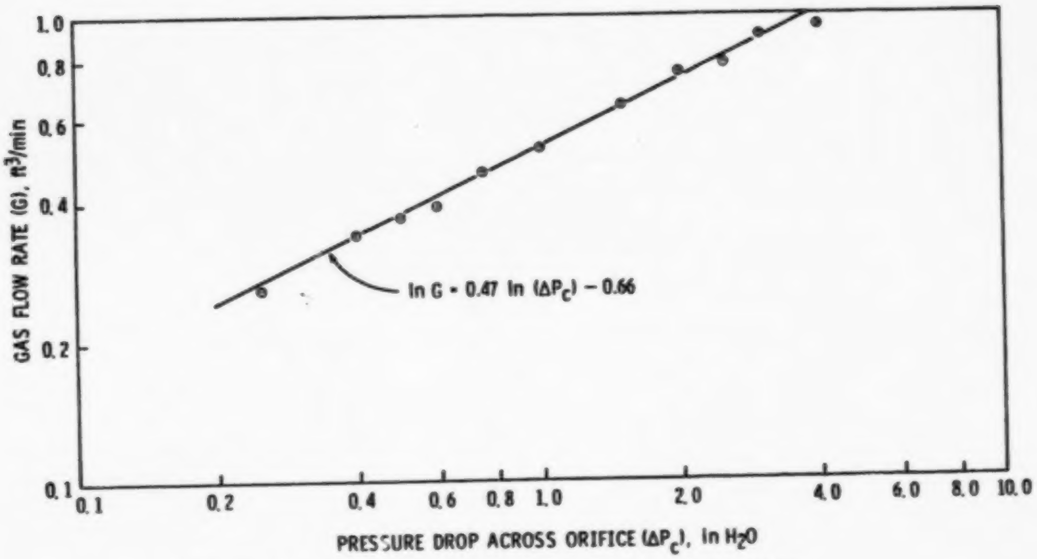

Figure G-1. Calibration curve for brass orifice ($P = 29.30$ in Hg; $T = 75°F$).

TABLE G-2. CALIBRATION DATA FOR FUGITIVE EMISSION SAMPLING TRAIN - STAINLESS STEEL ORIFICE[a]

Pressure drop across orifice, in H_2O	Run time, min	Volume of gas, ft^3	Flow rate, ft^3/min
0.25	11	5.20	0.47
0.40	8	5.35	0.67
0.50	8	5.51	0.69
0.60	9	6.75	0.75
0.75	7	5.76	0.82
1.0	9	8.36	0.93
1.5	5	5.44	1.09
2.0	5	6.12	1.22
2.5	5	6.73	1.35
3.0	5	7.20	1.44
4.0	4	6.38	1.60
4.5	–[b]	–[b]	2.07
5.0	–[b]	–[b]	2.13

[a] Barometric pressure during calibration = 29.30 in Hg; temperature during calibration = 76°F = 536°R.

[b] Data not available.

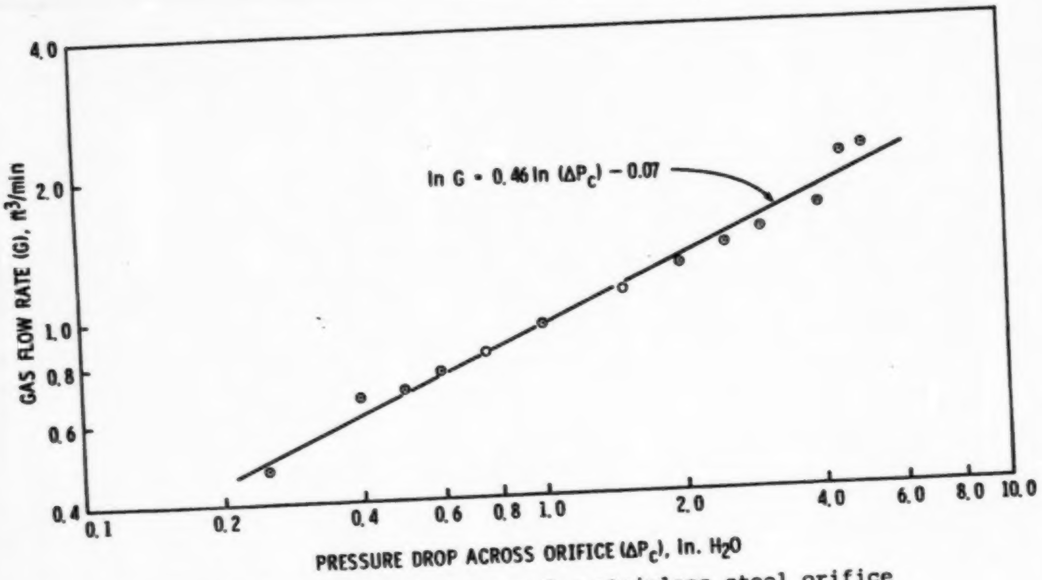

Figure G-2. Calibration curve for stainless steel orifice (P = 29.30 in Hg; T = 76°F).

TABLE G-3. INPUT DATA AND OUTPUT FROM DETERMINATION OF GAS FLOW RATE DURING FUGITIVE EMISSION SAMPLING

Sample type and run number	Sampling conditions		Observed pressure drop,[a] in H_2O	Corrected pressure drop,[b] in H_2O	Flow rate at calibration conditions,[c] ft³/min	Flow rate at sampling conditions,[d] ft³/min
	Temperature, °F	Pressure, in Hg				
Ground seepage:						
G-1	94	23.68	0.46	0.59	0.40	0.52
G-2	92	23.64	0.47	0.60	0.41	0.52
G-3	86	23.67	0.46	0.58	0.40	0.51
G-4	88	23.67	0.49	0.62	0.41	0.52
G-5	97	23.62	0.49	0.63	0.42	0.54
G-6	90	23.62	0.47	0.60	0.41	0.52
G-7	79	23.60	0.46	0.58	0.40	0.50
G-8	71	23.64	1.6*	2.0	1.3	1.6
G-9	78	23.64	0.46	0.57	0.40	0.50
G-10	80	23.64	0.48	0.60	0.41	0.51
G-11	73	23.63	0.47	0.58	0.40	0.50
G-12	72	23.63	0.47	0.58	0.40	0.49
G-13	83	23.58	0.48	0.61	0.41	0.52
G-14	76	23.57	0.45	0.56	0.39	0.49
G-15	77	23.56	0.46	0.57	0.40	0.50
G-16	75	23.55	0.47	0.58	0.40	0.50
G-17	71	23.60	0.46	0.57	0.40	0.49
G-18	78	23.60	0.47	0.59	0.40	0.51
G-19	79	23.59	0.48	0.60	0.41	0.51
G-20	81	23.60	0.47	0.59	0.40	0.51
G-21	80	23.59	0.46	0.58	0.40	0.50
G-22	78	23.58	0.47	0.59	0.40	0.51
G-23	75	23.56	0.48	0.60	0.41	0.51
G-24	81	23.56	0.46	0.58	0.40	0.50
G-25	82	23.54	0.47	0.59	0.40	0.51
G-26	78	23.53	0.46	0.58	0.40	0.50
G-27	82	23.52	0.47	0.59	0.40	0.51
Liquid production well:						
P-1	93	23.64	4.6*	5.9	2.1	2.7
Thermocouple wells:						
T-1	93	23.68	1.3*	1.7	1.2	1.5
T-2	80	23.64	1.4*	1.7	1.2	1.5
T-3	74	23.63	1.4*	1.7	1.2	1.5
T-4	81	23.63	1.3*	1.6	1.2	1.5
T-5	88	23.60	1.6*	2.0	1.3	1.6
T-6	93	23.59	1.9*	2.4	1.4	1.8

[a] Obtained using the brass orifice, except in those instances indicated by an asterisk (*), in which the steel orifice was used.

[b] Corrected to calibration conditions, as described in Section 5.

[c] Determined from Figure G-1 (brass orifice) or Figure G-2 (steel orifice).

[d] Calculated from flow rate at calibration conditions, as described in Section 5.

TABLE G-4. GAS CHROMATOGRAPHIC ANALYSIS OF FUGITIVE EMISSION SAMPLES FOR TOTAL HYDROCARBONS

Sample type and run number	Total hydrocarbon (THC) concentration (as CH_4),[a] ppmv[b]		Average THC concentration (as CH_4), ppmv	Average THC concentration (as CH_4), corrected for blank,[c] ppmv
	1,050 ppmv CH_4 std.	10,500 ppmv CH_4 std.		
Ground seepage:				
G-1	2,600	2,200	2,400	2,400
G-2	350	360	360	320
G-3	11,000	12,000	12,000	12,000
G-4	8,900	9,500	9,200	9,200
G-5	12,000	13,000	12,000	12,000
G-6	4,700	5,000	4,800	4,800
G-7	280	300	290	250
G-8[d]	490	530	500	460
	490	520		
	490	480		
G-9	3,200	2,700	3,000	2,900
G-10	6,200	5,300	5,700	5,700
G-11	17,000	14,000	16,000	15,000
G-12	9,200	8,300	8,700	8,700
G-13[d]	4,200	4,400	4,700	4,600
	4,900	5,200		
G-14	6,100	6,300	6,200	6,100
G-15	1,400	1,400	1,400	1,400
G-16	780	820	800	760
G-17	7,200	7,500	7,300	7,300
G-18	4,100	4,200	4,200	4,100
G-19	2,000	2,100	2,000	2,000
G-20	300	310	300	260
G-21	220	230	220	180
G-22	450	470	460	420
G-23	2,700	2,800	2,800	2,700
G-24	5,900	6,200	6,100	6,000
G-25	2,400	2,500	2,500	2,400
G-26	6,700	7,000	6,800	6,800
G-27	2,000	2,100	2,000	2,000
Liquid production well:				
P-1[d]	3,300	3,400	3,500	3,400
	3,600	3,600		
Thermocouple wells:				
T-1[e]	-	-	-	-
T-2	3,600	3,900	3,800	3,700
T-3	2,700	2,900	2,800	2,800
T-4	5,200	5,600	5,400	5,300
T-5	3,800	4,100	3,900	3,900
T-6	1,900	2,100	2,000	2,000

[a] Determined from methane (CH_4) standards at the indicated concentrations.

[b] Parts per million, by volume.

[c] Calculated by subtraction of blank concentration (i.e., 40 ppmv) from average total hydrocarbon concentration.

[d] Multiple analyses of sample were performed against both standards.

[e] Thermocouple well sample no. T-1 was not analyzed.

TABLE G-5. QUANTIFICATION OF C_1-C_6 HYDROCARBON FRACTIONS IN SELECTED FUGITIVE EMISSION SAMPLES

Sample type and run number	Concentration,[a] parts per million, by volume					
	C_1	C_2	C_3	C_4	C_5	C_6
Ground seepage:						
G-4	1,700	360	100	20	50	5
G-11	2,900	650	240	160	90	8
G-14	1,200	330	100	80	20	3
G-17	1,700	480	190	110	50	7
G-24	1,300	360	120	110	50	4
Liquid production well:						
P-1	740	240	90	40	20	1
Thermocouple well:						
T-2	810	200	60	50	20	3

[a] Based on duplicate gas chromatographic analyses of one sample in each case, except for sample No. G-4, for which only one analysis was performed.

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Cookinsville
DATE 7-20-79
SAMPLING TIME (24-hr CLOCK) 10:00 AM
SAMPLING LOCATION Fugitive Sample G-9
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 95°
OPERATOR W. McDONALD

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	.2	0.2	0.2	0.2			0.2	44/100	0.1
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	10.8	10.6	10.8	10.6			10.6	32/100	3.4
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	11.8	1.0	11.8	1.0			1.0	28/100	0.3
N_2 (NET IS 100 MINUS ACTUAL CO READING)				88.2			88.2	28/100	24.7
								TOTAL	28.5

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4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Geo Kinetics

DATE 7-21-79

SAMPLING TIME (24-hr CLOCK) 1430

SAMPLING LOCATION Fugitive G-13

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE 78°

OPERATOR W. McDONALD

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	44/100	2.2
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	12.0	7.0	12.0	7.0	12.0	7.0	7.0	32/100	2.24
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	13.0	1.0	13.2	1.2	13.0	1.0	1.07	28/100	0.2996
N_2 (NET IS 100 MINUS ACTUAL CO READING)	87.0		86.8		87.0		86.93	28/100	24.34
								TOTAL	29.08

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Geokinetics
DATE 7-23-79
SAMPLING TIME (24-hr CLOCK) 11:20
SAMPLING LOCATION Site G-18
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 83°
OPERATOR W. McDonald

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	4.0	4.0	4.0	4.0	—	–	4.0	44/100	1.76
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	11.2	7.2	11.2	7.2	—	—	7.2	32/100	2.304
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	12.0	0.8	12.0	0.8	—	–	0.8	28/100	0.224
N_2 (NET IS 100 MINUS ACTUAL CO READING)		88.0		88.0			88.0	28/100	24.64
								TOTAL	28.928

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Geokinetics
DATE 7/23/79
SAMPLING TIME (24-hr CLOCK) 1100
SAMPLING LOCATION G-24 FUGITIVES
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 85°
OPERATOR W. McDONALD

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	8.0	8.0	8.0	8.0			8.0	44/100	3.52
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	13.8	5.8	13.8	5.8			5.8	32/100	1.856
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	13.8	0	13.8	0			0	28/100	0
N_2 (NET IS 100 MINUS ACTUAL CO READING)		86.2		86.2			86.2	28/100	24.14
								TOTAL	29.516

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Geokinetics
DATE 7/24/79
SAMPLING TIME (24-hr CLOCK) 1145
SAMPLING LOCATION Fugitive Sample # T-4
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 90°
OPERATOR W. H. McDonald

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	3.6	3.6	3.6	3.6	3.6	3.8	3.6	44/100	1.584
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	11.0	7.4	11.0	7.4	11.0	7.4	7.4	32/100	2.368
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	12.8	1.8	12.7	1.7	12.8	1.8	1.75	28/100	0.49
N_2 (NET IS 100 MINUS ACTUAL CO READING)		87.2		87.3		87.2	87.23	28/100	24.42
								TOTAL	28.86

EPA (Dur) 230
4/72

APPENDIX H

ANALYTICAL DATA FOR DETERMINATION OF WATER QUALITY PARAMETERS AND CONVENTIONAL AND PRIORITY POLLUTANTS

This appendix contains: analyses of Geokinetics water samples by Howard Laboratories, Inc., Dayton, Ohio, for water quality parameter and conventional pollutants; analyses of quality control samples; analyses for organic priority pollutants by MRC; and detection limits for the priority pollutants.

ANALYSIS REPORT	DATE September 12, 1979	cc: Files cu
TO G. Rinaldi	RECORD NUMBER 1-79-08-02-07	
FROM **ANALYTICAL SERVICES** **MONSANTO RESEARCH CORPORATION** **Dayton, Ohio**	PROJECT NUMBER 13-022-760.51-104.0136 NOTEBOOK REFERENCE Howard Labs #27-28-29-30	

Title: Water Analyses of Oil Shale Samples

Method: Various (as performed by Howard labs)

See following pages for results

QC Results (Oil Shale #2 and Oil Shale #1)

Where known true values are given on following page.

Previous analysis of Oil Shale #1 by Howard labs provided the following results:

Analyte	Analysis on 8/10	Analysis reported 9/11
Fluoride	1.16 mg/l	1.23 mg/l
Chloride	9.4	7.8
Hardness	<1	<1
TDS	<1	142

ANALYST: Connie [illegible]

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**HOWARD
LABORATORIES
INC.**

**3601 S. DIXIE
DAYTON, OHIO 45439
(513) 294-6856**

P. O. Box 369
Dayton, Ohio 45449

September 11, 1979

ANALYTICAL RESULTS

No. 2928 ur

MONSANTO RESEARCH CORPORATION
1515 Nicholas Road
Dayton, Ohio 45418

Samples: Aqueous Samples Received 8-8-79

Charge No. 13-022-760.51-104.0136
Log No. 1-79-08-02-07

	Hardness
Evap. Pond (Plastic bottle)	122.56 mg/L

	Ammonia-N	Nitrate-N	Ortho-phosphate as P
Oc 010 - Oil Shale #2	1.5 mg/L	0.40 mg/L	0.181 mg/L
Truevalue	(1.59)	(0.38)	(0.19)

Approved

ENVIRONMENTAL CONSULTING **WATER QUALITY MONITORING**
BACTERIOLOGICAL & CHEMICAL ANALYSES

**HOWARD
LABORATORIES,
INC.**

3601 S. DIXIE
DAYTON, OHIO 45439
(513) 294-6856
P. O. Box 369
Dayton, Ohio 45449

September 11, 1979

ANALYTICAL RESULTS

No. 2929 ok

MONSANTO RESEARCH CORPORATION
1515 Nicholas Road
Dayton, Ohio 45418

Samples: Aqueous Samples Received 8-8-79

Charge No. 13-022-760.51-104.0136
Log No. 1-79-08-02-07

	Oil Shale #1 (OC std)		
pH	7.5		
Conductivity	91	umhos	
Total Dissolved Solids	142	mg/L	
Total Hardness	<1	"	
Total Alkalinity	77	"	(74.7 mg/l)
Chloride	7.8	"	
Fluoride	1.23	"	(1.30 mg/l)
Sulfate *	--		

* Test cancelled per Connie Hayes.

(Analyses on Phenol Bottles)	Retort Water mg/L	Evap. Pond Water mg/L	
Nitrogen, Ammonia as N	870	1,200	as N
Nitrogen, Kjeldhal as N	1,225	1,250	
Nitrogen, Nitrate as N	9,500	20,000	
COD	7,243	10,905	
Oil & Grease	186	648	
TOC	2,150	2,895	

Approved

ENVIRONMENTAL CONSULTING WATER QUALITY MONITORING
BACTERIOLOGICAL & CHEMICAL ANALYSES

**HOWARD
LABORATORIES,
INC.**

3601 S. DIXIE
DAYTON, OHIO 45439
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P. O. Box 369
Dayton, Ohio 45449

September 11, 1979

No. 2930 CK

ANALYTICAL RESULTS

MONSANTO RESEARCH CORPORATION
1515 Nicholas Road
Dayton, Ohio 45418

Samples: Aqueous Samples Received 8-8-79

Charge No. 13-022-760.51-104.0136
Log No. 1-79-08-02-07

	Retort Water	Evap. Pond Water
(Analyses on Gallon Containers)	mg/L	mg/L
Chloride	1,098	3,333
Bicarbonate	5,384	10,768
Carbonate	172.7	345.4
Inorganic Carbon	1,100	2,200
Fluoride	15.6	41.60
Nitrogen, Ammonium Ion as N	316.9	437.1
Nitrogen, Nitrite as N	0.083	0.067
Nitrogen, Organic as N	355	50
Sulfur	1,233	4,168
Sulfate ($SO_4^{=}$)	825.0	3,075.0
Sulfite ($SO_3^{=}$)	400	1,145
Sulfide ($S^{=}$)	0.214	1.14
Tetrathionate ($S_4O_6^{=}$)	1,080	3,700
Thiosulfate ($S_2O_3^{=}$)	<25	~25
Thiocyanate (SCN^{-})	325	1,025
Alkalinity	16,600	22,400
BOD	1,988	-----
Total Solids	1.02 %	2.91 %
Total Volatile Solids	18.22 %	14.66 %
Total Dissolved Solids	0.94 %	2.84 %
Total Volatile Dissolved Solids	22.30 %	14.18 %
Hardness	33.88	----- 122.56
Ortho Phosphate as P	1.30	1.77
Total Phosphorus as P	4.30	1.77
Conductivity	11,200 umhos	20,000 umhos
pH	8.9	8.9

Approved

TABLE H-1. COMPARISON OF TRUE AND MEASURED CONCENTRATIONS IN QUALITY CONTROL SAMPLES SUBMITTED FOR WATER ANALYSIS

Component	Concentration, mg/L	
	True	Measured
Alkalinity (as $CaCO_3$)	74.7	77
Cyanide (as CN^-)	0.016	0.016
Fluoride	1.3	1.23
Nitrogen, ammonia (as N)	1.59	1.5
Nitrogen, nitrate (as N)	0.38	0.40
Orthophosphate (as P)	0.19	0.181

ANALYSIS REPORT	**DATE** 10/8/79	**cc:** Files F. Kulik CM
TO J. Rinaldi ~~D. DeAngelis~~	**RECORD NUMBER** 1-79-08-02-09	
FROM Env. Sampling & Characterization MONSANTO RESEARCH CORPORATION Dayton, Ohio	**PROJECT NUMBER** 104.0136 **NOTEBOOK REFERENCE** 1207343-44	

CN^- ANALYSIS METHOD: Auto Analyzer

Sample No.	CN^-, ppm
RETORT WATER -1	95
Evap. Pond WATER-2	266

QC Results:

ERA Std Reference Sample:

Obs value = 0.016 mg/ℓ CN^-

True value = 0.016 mg/ℓ

Duplicate Runs:

Retort Water-1	93.3, 96.2	mg/ℓ
Evap Pond Water-2	264.2, 2647	mg/ℓ

Analyst: Norman E. May

ANALYSIS REPORT	DATE 8/15/79	cc: Files Delaney F. Kulik CM
TO J. Delaney	RECORD NUMBER 1-79-08-02-08	
FROM Env. Sampling & Characterization MONSANTO RESEARCH CORPORATION Dayton, Ohio	PROJECT NUMBER 13-022-760.51-104.0136	
	NOTEBOOK REFERENCE 1566162	

Title: Oil Shale Phenol Sample Results

Method: Auto Analyzer

Sample	Phenol Concentration, mg/l
Retort Water	37.8
Evaporation Pond Water	24.0

Analyst: Michael Arnold

ANALYSIS REPORT

TO	G. Rinaldi	DATE	9-21-79
		RECORD NUMBER	1-79-05-02-07 and 11.
FROM	ANALYTICAL LABORATORIES MONSANTO RESEARCH CORPORATION DAYTON 7, OHIO	PROJECT NUMBER	104.0136

CC Brooks
Kulik/fi

SUBJECT

Priority Pollutant Analysis for volatiles, base/neutrals and acids on 2 samples, identified as ① Retort Water, and ② Evap. Pond Water, and one organic free water method blank.

The entire analysis was conducted in conformance to the April 1977 USEPA Sampling and Analysis procedures for screening of Industrial Effluents for priority pollutants.

The pollutants detected are shown in Table 1, and the detection limits for the priority pollutants are given in Table 2.

D. Shang

TABLE 1
PRIORITY POLLUTANTS

	CONCENTRATION (µg/L)		
	5307 Retort Water	5308 Evap. Pond. Water	530 Method Blank
FLUORENE	–[a]	–	0.4
ACENAPHTHYLENE	11.	92.	–
BIS (2-ETHYLHEXYL) PHTHALATE	0.5	3.8	9.0
ANTHRACENE/PHENANTHRENE	3.6	10.	1.3
DIETHYL PHTHALATE	–	3.5	13.
DI-N-BUTYL PHTHALATE	–	0.8	0.6
DIMETHYL PHTHALATE	–	–	1.8
BUTYL BENZYL PHTHALATE	–	–	0.5
DI-N-OCTYL PHTHALATE	–	1.5	0.6
PHENOL	670.	230.	–
METHYLENE CHLORIDE	11.	22.	0.8
TRICHLOROETHYLENE	1.7	2.8	1.4
BENZENE	370.	67.	0.5
TETRACHLOROETHYLENE	0.9	0.5	–
TOLUENE	280.	64.	3.6
ETHYLBENZENE	45.	29.	0.2
CHLOROFORM	–	2.0	–
ACROLEIN	–	360.	–
ACRYLONITRILE	250.	1700.	–
FLUORANTHENE	–	8.3	–
PYRENE	–	3.2	–
CHRYSENE	–	0.9	–

a - Dash indicates that, if present, concentration is below detection limits (See Table 2).

NON-PRIORITY POLLUTANTS OBSERVED.

ACETONE	~ 4000.	~ 900.	~ 50
XYLENES	~ 250.	~ 68.	~ 0.5
n-propyl benzene	~ 120.	~ 49.	
Trimethyl benzene		~ 400.	

TABLE H-2. DETECTION LIMITS[a] FOR ORGANIC PRIORITY POLLUTANTS

Compound	Concentration, μg/liter	Compound	Concentration, μg/liter
Acids:		**Base/Neutrals:**	
2-Chlorophenol	0.09	1,3-Dichlorobenzene	0.02
Phenol	0.07	1,4-Dichlorobenzene	0.04
2,4-Dichlorophenol	0.1	Hexachloroethane	0.1
2-Nitrophenol	0.4	1,2-Dichlorobenzene	0.05
p-Chloro-*m*-cresol	0.1	Bis(2-chloroisopropyl) ether	0.06
2,4,6-Trichlorophenol	0.2	Hexachlorobutadiene	0.08
2,4-Dimethylphenol	0.1	1,2,4-Trichlorobenzene	0.09
2,4-Dinitrophenol	2.0	Naphthalene	0.007
4,6-Dinitro-*o*-cresol	40.0	Bis(2-chloroethyl) ether	0.07
4-Nitrophenol	0.9	Hexachlorocyclopentadiene	0.2
Pentachlorophenol	0.4	Nitrobenzene	0.08
		Bis(2-chloroethoxy) methane	0.06
Volatiles:		2-Chloronaphthalene	0.02
Chloromethane	5.0	Acenaphthylene	0.02
Dichlorodifluoromethane	2.0	Acenaphthene	0.04
Bromomethane	5.0	Isophorone	0.06
Vinyl chloride	5.0	Fluorene	0.02
Chloroethane	5.0	2,6-Dinitrotoluene	0.2
Methylene chloride	0.1	1,2-Diphenylhydrazine	0.02
Trichlorofluoromethane	0.3	2,4-Dinitrotoluene	0.02
1,1-Dichloroethylene	0.5	N-nitrosodiphenylamine	0.07
1,1-Dichloroethane	0.4	Hexachlorobenzene	0.05
Trans-1,2-dichloroethylene	0.7	4-Bromophenyl phenyl ether	0.1
Chloroform	0.3	Phenanthrene	0.01
1,2-Dichloroethane	2.0	Anthracene	0.01
1,1,1-Trichloroethane	0.3	Dimethyl phthalate	0.03
Carbon tetrachloride	0.4	Diethyl phthalate	0.03
Bromodichloromethane	0.3	Fluoranthene	0.02
Bis(chloromethyl) ether	5.0	Pyrene	0.01
1,2-Dichloropropane	0.8	Di-n-butyl phthalate	0.02
Trans-1,3-dichloropropene	0.7	Benzidine	0.02
Trichloroethylene	0.2	Butyl benzyl phthalate	0.03
Dibromochloromethane	0.4	Chrysene	0.02
Cis-1,3-dichloropropene	1.5	Bis(2-ethylhexyl) phthalate	0.04
1,1,2-Trichloroethane	0.5	Benz(a)anthracene	0.02
Benzene	0.2	Benzo(b)fluoranthene	0.02
2-Chloroethyl vinyl ether	5.0	Benzo(k)fluoranthene	0.02
Bromoform	1.0	Benzo(a)pyrene	0.02
Tetrachloroethylene	0.2	Indeno(1,2,3-cd)pyrene	0.02
1,1,2,2-Tetrachloroethane	0.3	Dibenzo(a,h)anthracene	0.02
Toluene	0.1	Benzo(g,h,i)perylene	0.01
Chlorobenzene	0.2	N-Nitrosodimethylamine	0.8
Ethylbenzene	0.1	N-nitrosodi-n-propylamine	0.2
		4-Chlorophenyl phenyl ether	0.03
Direct Injectables:		3,3'-Dichlorobenzidine	1.0
Acrolein	200	Di-n-octyl phthalate	0.9
Acrylonitrile	100		

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[a] Based on the lowest quantifiable area obtained from gas chromatography mass spectrometry.